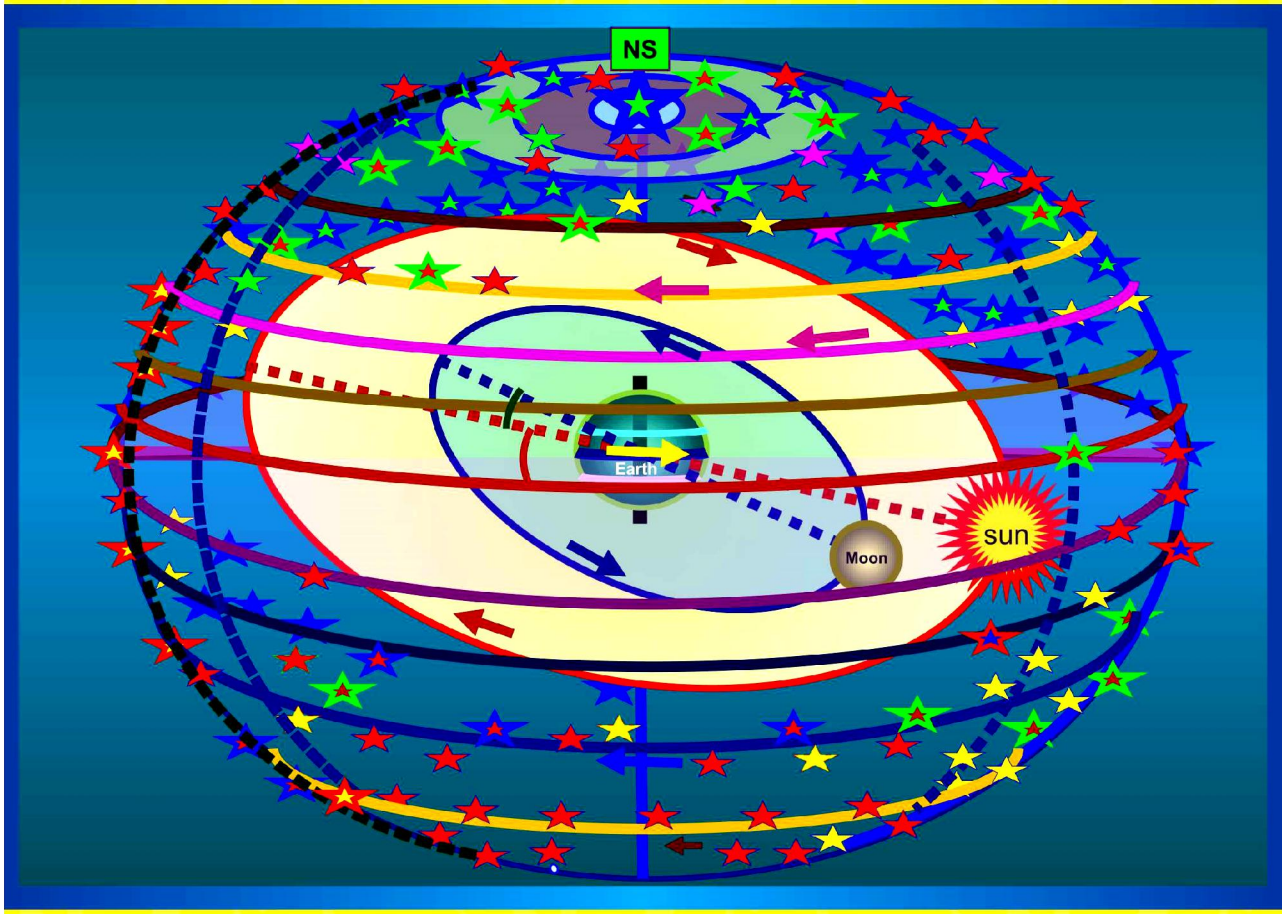
THE SUN AND THE STARS ARE SET IN MOTION

NEW MODEL OF SOLAR SYSTEM

LEGITIMATE REFUTATION OF HELIOCENTRIC MODEL



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بسم الله الرحمن الرحيم

وما توفيقي إلا بالله

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِيْمِ

اَللّٰهُمَّ صَلِّ عَلٰى مُحَمَّدٍ

وَّعَلٰى اٰلِ مُحَمَّدٍ كَمَا صَلَّيْتَ

عَلٰى اِبْرَاهِيْمَ وَعَلٰى اٰلِ اِبْرَاهِيْمَ

اِنَّكَ حَمِيْدٌ مَّجِيْدٌ ۝

اَللّٰهُمَّ بَارِكْ عَلٰى مُحَمَّدٍ وَّعَلٰى

اٰلِ مُحَمَّدٍ كَمَا بَارَكْتَ عَلٰى

اِبْرَاهِيْمَ وَعَلٰى اٰلِ اِبْرَاهِيْمَ

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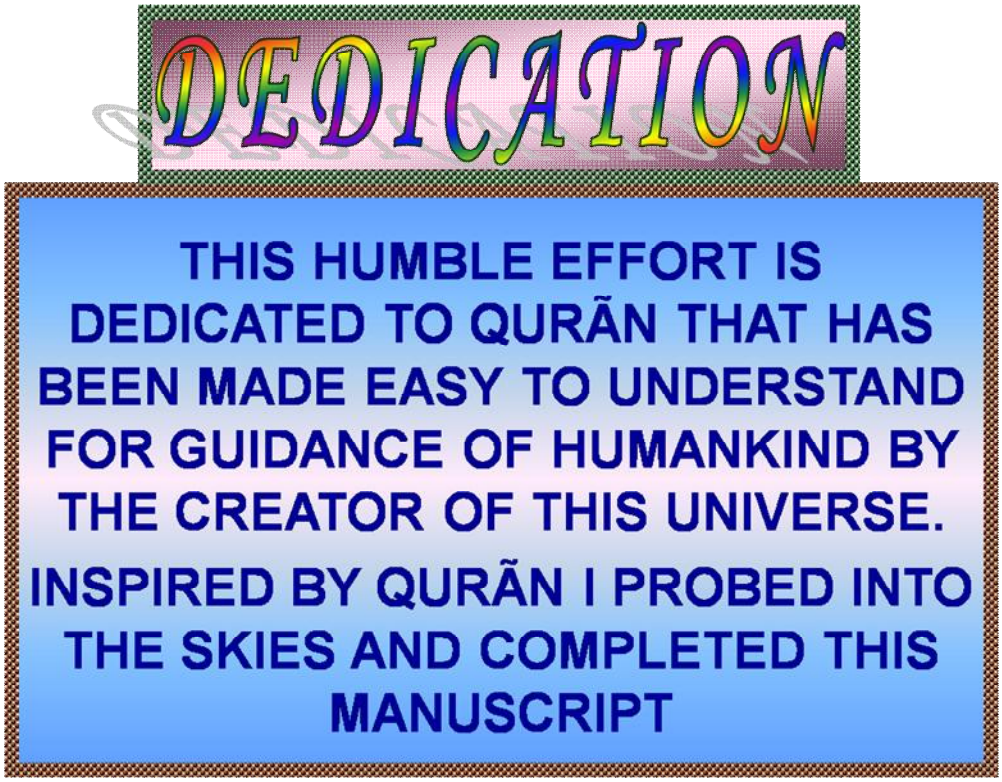
DEDICATION
THIS HUMBLE EFFORT IS DEDICATED TO QURÃN THAT HAS BEEN MADE EASY TO UNDERSTAND FOR GUIDANCE OF HUMANKIND BY THE CREATOR OF THIS UNIVERSE.
INSPIRED BY QURÃN I PROBED INTO THE SKIES AND COMPLETED THIS MANUSCRIPT

ACKNOWLEDGEMENT

Thanks to my daughter Ayesha and son Ammar who realized the importance of this work and never distracted me during hours of profound concentration. They also contributed in this work by making two diagrams. I have no words to express my feelings for my parents who taught me the first word of Qurãn that moved me to probe into the skies. Allah bless them forever in heavens. Endless thanks to my wife who made me to wake at night and study the skies in peace.

Special thanks to my friend Nusrat Ali, Wing Commander (R) Pakistan Air Force who was always anxious for completion of this work and provided all kind of help as and when needed. Acknowledgement is also due to my colleagues who always encouraged and helped me for this work.

Prof. Dr. Abdul Razzaq

PROLOGUE

"And He has subjected to your service the night and the day, the sun and the moon; and the stars are also subservient by His command; surely there are signs for those who are rational" (16:12).

During my stay at University of Agriculture Faisalabad Pakistan (1986-88) for M. Sc. (Hons.) Agri. degree I was astonished to read several verses of Qurãn categorically affirming the revolution of the sun and the moon diligently following the computed courses. Some verses also manifested the movement of the stars. Nonetheless, presently prevailing heliocentric theory asserts immobility of the sun and the stars although the Muslims' and Christians' holy books do not support this concept. These books reveal mobility of the sun, the stars and the moon and immobility of the earth. Qurãn proclaims the motion of the sun and the moon thereby implying non-heliocentric solar system. *"And the sun runs onto the place specified for it" (Surah No. 36: Verse No.38); "The sun and the moon follow the courses (exactly) computed" (55:5); "He subjected the sun and the moon, each running its course with specified period" (13:2); "And He has made subject to you, the sun and the moon; both diligently pursue their courses" (14: 33).* These and several other verses provide undoubted evidence for the motion of the moon and the sun in specified orbits with certain principles for a designated period. Mobility of the sun and thereby, immobility of the earth is envisaged from these verses. Bible states, *"Thou hast fixed the earth immovable and firm" (Psalm 93, addressing God)* and hence favors geocentric concept rather than heliocentric. Motion of the stars is also indicated from the verses of Qurãn. *"He made the signposts; but with help of the star you guide yourself" (16:16).* After reviewing these injunctions from the holy books, it becomes evident that the sun and the stars are set in motion thereby contradicting with the concepts of heliocentric theory. Nevertheless, sayings of the holy books may not be persuasive for the people living in the world of science. Therefore, it was crucial to understand and assess existing concepts employing the principles of science, mathematics and logic. I humbly requested Allah Almighty to bless me with the understanding of the solar system and enable me to prove scientifically that it is the sun that revolves around the earth. The sky was the place that could provide necessary evidences required to comprehend true nature of the solar system, so I started viewing the sky with profound concentration. The first thing that I concluded from the sky was the movement of the stars. I collected several evidences but still insufficient to disprove heliocentric model. However, I did not give up and continued probing into the system for more than seventeen years.

The very first model proposed by Heraclides (330BC) was geocentric. Claudius Ptolemaeus (127-145 AD) also proposed geocentric model that remained widely accepted until 15th century. However, some people believed that the sun occupied the central position and favored heliocentric concept. Heliocentric model proposed by Nicolas Copernicus (1473-1543AD) got wider acceptance and is still prevailing. His perception and description of the solar system was more scientific. New scientific development in that era further strengthened heliocentric doctrine. This model described the sun as stationary and relegated the earth as a planet revolving round the sun. Nonetheless, this model did not conform to the conjunctions of Qurãn and Bible. I had a very strong belief that the verses of Qurãn are certainly true in letter and spirit. Consequently I had a feeling that solar system had been misconstrued.

The people believing in the authenticity of holy books had to yield because no one could rebut heliocentric model due to lack of scientific and mathematical evidences. Therefore, the author decided to critically review the heliocentric concept of solar system that is based on several assumptions. Denial of heliocentric model should stem from scientific evidences. This model when subjected to mathematical, scientific and logical evaluation could not prove its rationale. I could prove scientific inability of heliocentric model. However, I was not able to present an alternate model precisely explaining all aspects of relative motion of the stars, the sun and the

moon with respect to the earth with the help of established observations and the recent numerical values. Nevertheless, special blessings of Allah Almighty were there to help guide me and a comprehensive model was developed ultimately in 2015. *Al-Hamd-o-Lillah*. To Allah Almighty, Who Created the Universe and all objects therein following definite principles prescribed by Him, in debt I remain. All kinds of praises are due to Him. *Salat-o-Salam* for His Prophet Mohammad (peace be upon him).

Several people will wonder why the validity of heliocentric model was not challenged for a long time. This is not true. Several persons never accepted heliocentric model but they could not provide scientific evidences for its refutation. Furthermore, an alternate model satisfying all aspects of relative motions of the sun, the moon, the stars and the earth could not be presented. Therefore, the heliocentric model continued to prevail as the most plausible scientific explanation of the solar system.

Heliocentric model is hereby challenged and denied. In this book substantial evidences based on scientific principles, mathematical calculations, definite observations, logical and deductive reasoning have been presented that provide sufficient grounds for legitimate refutation of orbital revolution of the earth as perceived in heliocentric theory. A new comprehensive model, more scientific and mathematical in nature, is presented that perfectly fits with the most recent numerical values without any assumption. Mathematical, scientific and logical evidences provided in this book may be assessed critically for their legitimacy. Comparative judgment of the two models will explicitly manifest that the heliocentric model was an illusion without any scientific justification.

Dr. Abdul Razzaq

April 23, 2016

Prologue in Urdu

زمین سورج کے گرد نہیں گھومتی بلکہ سورج زمین کے گرد گھومتا ہے

۔ "اور اُس نے مُسخّر کئے رات اور دن،اور سورج اور چاند ؛اور ستارے بھی اُس کے حکم سے مُسخّر ہیں۔بیشک اِس میں نشانیاں ہیں عقلمندوں کیلئے"۔(النحل:۱۲)

ایم ایس سی (آنرز) ایگریکلچر کی ڈگری کے حصول (88-1986ء) کے دوران میں نے دیکھا کہ قُرآن کی بُہت سی آیات دوٹوک تصدیق کرتی ہیں کہ چاند اور سورج قاعدے اور قوانین کے مطابق مقرر کردہ راستوں پر چلتے ہیں۔ کُچھ آیات سے ستاروں کی گردش بھی عیاں ہوتی ہے۔تاہم موجودہ Heliocentric model (سورج مرکز ماڈل) سورج کو نظامِ شمسی کا مرکز اور زمین کے لحاظ سے غیر متحرک رساکن (immobile) تصوّر کرتا ہے اور ستاروں کو بھی ساکن مانتا ہے۔مسلمانوں اور عسائیوں کی مذہبی کتابیں سورج مرکز ماڈل (Heliocentric) کی تصدیق نہیں کرتیں۔ یہ کتابیں سورج، چاند اور ستاروں کے متحرک (mobile) اور زمین کے غیر مُتحرک ہونے کا اعلان کرتی ہیں۔قُرآن واضح طور پر چاند،سورج اور ستاروں کے مُتحرک ہونے کا بیان کرتا ہے اور سورج مرکز ماڈل (Heliocentric) کی تصدیق نہیں کرتا۔

"اور سورج چلتا ہے مقرر کردہ راستے پر"(۳۶:۳۸)۔"اور سورج اور چاند حسابی قاعدے کے مطابق چلتے ہیں"(۵۵:۵)۔"اور سورج اور چاند مُسخّر کر دیئے ،ہر ایک اپنے مقرر کردہ راستے پر چلتا ہے ایک مخصوص کردہ مدّت (Period) کے حساب سے"(۱۳:۲)۔"اور اُس نے سورج اور چاند کو کام پر لگایا، دونوں مقرّرہ قوانین کے پابند ہیں"(۱۴:۳۳)۔

مندرجہ بالا اور اِس طرح کی دوسری آیات چاند اور سورج کے اپنے مقرّر کردہ راستوں پر چلنے کا ثبوت مہیّا کرتی ہیں۔سورج کا متحرک ہونا اِن آیات سے عیاں ہوتا ہے جبکہ زمین غیر مُتحرک (immobile) ہے۔ بائبل میں لکھا ہے کہ "اُس نے زمین کو غیر متحرک اور مستحکم بنایا ہے (بحوالہ Psalm 93, addressing God)۔اِس طرح آسمانی کتابیں سورج مرکز ماڈل (Heliocentric) کی بجائے زمین مرکز ماڈل (Geocentric) کے تصور کی حامی ہیں۔ستاروں کی گردش بھی قُرآنی آیات سے عیاں ہے۔"اُس نے نشانیاں (Signposts/Constellations) بنائیں اور ستارہ (Northstar) کی مدد سے تم راہ معلوم کرتے ہو(Navigation with the help of Northstar)"(۱۶:۱۶)۔آسمانی کتابوں سے سورج اور ستاروں کی گردش واضح ہوتی ہے۔جو کہ سورج مرکز ماڈل (Heliocentric) کے تصور کی نفی کرتا ہے۔

تاہم آسمانی کتابوں کے فرمودات اِن لوگوں کو قائل نہیں کر سکتے جو کہ سائنس پر یقین رکھتے ہیں۔چنانچہ اِس چیز کی اشد ضرورت تھی کہ نظامِ شمسی کے موجودہ تصورات کو سائنسی، ریاضی (Mathematics) اور منطق (Logic) کے اُصولوں اور قوانین کے مطابق سمجھا اور پرکھا جائے۔چنانچہ میں نے رَبِّ کریم سے عاجزانہ اِلتجا کی کہ مُجھے نظامِ شمسی کی سمجھ عطا کر اور مجھے اِس قابل بنا دے کہ سائنسی طور پر ثابت کر سکوں کہ سورج زمین کے گرد گھومتا ہے نہ کہ زمین سورج کے گرد گھومتی ہے۔آسمان وہ جگہ تھی جہاں سے نظامِ شمسی کی اصل حقیقت کو سمجھنے کے لیے ضروری ثبوت مہیّا ہو سکتے تھے چنانچہ میں نے راتوں کو اِنتہائی توجّہ کے ساتھ آسمانوں کا مطالعہ شروع کر دیا۔پہلی چیز جو کہ میرے مشاہدے میں آئی وُہ یہ تھی کہ ستارے ساکن نہیں بلکہ چلتے ہیں۔ میں نے بہت سے شواہد اکٹھے کر لیے لیکن ابھی بھی وہ سورج مرکز ماڈل کو غلط ثابت کرنے کیلئے ناکافی تھے۔لہٰذا میں نے کوشش جاری رکھی اور ۱۷ سال سے زیادہ آسمانوں کے مطالعہ میں صرف کر دیئے۔

نظامِ شمسی کا سب سے پہلا ماڈل 330-BC میں Heraclides نے پیش کیا جو کہ زمین مرکز ماڈل تھا۔ Claudius Ptolemaeus (۱۴۵۔۱۲۷ء) نے بھی زمین مرکز ماڈل پیش کیا جو کہ پندرھویں صدی تک قابلِ قبول رہا۔تاہم کچھ لوگوں کا خیال تھا کہ سورج کو نظامِ شمسی میں مرکزی حیثیت حاصل ہے۔Nicolaus Copernicus (۱۵۴۳۔۱۴۷۳ء) نے سورج مرکز ماڈل پیش کیا جس کو بڑی پزیرائی حاصل ہوئی اور ابھی تک

قابلِ قبول سمجھا جاتا ہے۔ اِس کی سوچ اور پیش کردہ ماڈل زیادہ سائنسی سمجھا گیا۔ اُس دور کی سائنسی ترقی نے اِس ماڈل کو مزید تقویت دی۔ اِس ماڈل کے مطابق سورج نظامِ شمسی کا مرکز اور غیر متحرک (Immobile) ہے اور زمین سورج کے گرد گھومتی ہے۔ تاہم یہ ماڈل قُرآن اور بائبل کے تصورات سے متصادم ہے۔ میرا راسخ یقین تھا کہ قُرآنی تصورات یقینی طور پر صحیح ہیں۔ چنانچہ میرا خیال تھا کہ نظامِ شمسی کا ماڈل بنانے میں غلط اندازہ لگایا گیا ہے۔

مقدّس مذہبی کتابوں پر یقین کرنے والے لوگ سورج مرکز ماڈل کو مانتے تو نہیں ہیں لیکن وُہ اِس ماڈل کی تردید کے لیے ضروری سائنسی اور ریاضیاتی شواہد پیش نہ کر سکے۔ چنانچہ میں نے موجودہ Heliocentric ماڈل (جو کہ مفروضات پر مبنی ہے) کے مکمل تجزیہ کا مصمّم ارادہ کر لیا۔ میرا خیال تھا کہ موجودہ ماڈل کو صرف سائنسی اور منطقی ثبوتوں کی بِنا پر ہی مُسترد کیا جا سکتا ہے۔ چنانچہ جب اِس ماڈل کا سائنسی، ریاضیاتی اور منطقی تجزیہ کیا گیا تو یہ ماڈل ریت کی دیوار ثابت ہوا۔ اَب مُجھے ربِّ کریم نے اِس قابل کر دیا تھا کہ سورج مرکز ماڈل (Heliocentric) کو سائنسی بنیادوں پر غلط ثابت کر سکوں لیکن میں ابھی اس قابل نہ تھا کہ متبادل ماڈل پیش کر سکوں جو کہ سورج، چاند اور ستاروں کی زمین کے لحاظ سے حرکت پزیری کے تمام پہلوؤں کو اُجاگر کر سکے۔ تاہم اللہ تعالیٰ کی مدد میرے شاملِ حال رہی اور آخر کار میں ۲۰۱۵ء میں ایک مکمل سائنسی اور ریاضیاتی ماڈل بنانے میں کامیاب ہو گیا۔ اَلْحَمْدُ لِلّٰہ میرا سر رَبُّ العالمین کی عظمت کے آگے، جس نے تمام کائنات کو پیدا کیا اور اِس کے اندر کی تمام چیزوں کو قوانین وضوابط کا پابند بنایا کے جُھکا ہوا ہے اور میرا دِل عطائے بے کنار اور جزبہءِ تشکر سے مغلوب ہے۔ کروڑوں درود وسلام سیّدِ ناومولٰنا محمد ﷺ پر جن کے وسیلے سے ہمیں قُرآن مِلا جو ہر شعبہ میں ہماری راہنمائی کرتا ہے۔

بُہت سے لوگ متعجب ہونگے کہ ۵۰۰ سال تک اِس Heliocentric ماڈل کو چیلنج کیوں نہ کیا گیا۔ ایسی بات نہیں، بے شمار لوگوں نے اِس ماڈل کو کبھی بھی قبول نہیں کیا لیکن وُہ اِسکی تردید کے لئے ضروری شواہد اور ثبوت پیش نہ کر سکے اور دوسرا یہ کہ متبادل ماڈل جو کہ ہر لحاظ سے سورج، چاند اور ستاروں کی گردش لِلحاظِ زمین بھی پیش نہ کیا جا سکا چنانچہ سورج مرکز ماڈل (Heliocentric) کو ہی نظامِ شمسی کی بہترین اور مؤثر سائنسی وضاحت سمجھا اور قبول کیا گیا۔

میں نے اپنی کتاب بعنوان **"The Sun and The Stars are set in Motion; New Model of Solar System, Legitimate Refutation of Heliocentric Model"** میں Heliocentric ماڈل کو چیلنج کیا ہے اور اِسے مسترد کیا ہے۔ اِس کتاب میں سائنسی اُصولوں، ریاضیاتی قوانین، مشاہدات اور منطقی استدلال کو بنیاد بنا کر ایسے شواہد پیش کیے ہیں جو کہ زمین کی مداری گردش (Orbital Revolution) کو مسترد کرنے کیلئے ٹھوس جواز مہیّا کرتے ہیں۔ علاوہ ازیں ایک نیا جامع سائنسی اور ریاضیاتی (Mathematical) ماڈل بھی پیش کیا گیا ہے جو حالیہ مشاہدات اور حسابی اعداد وشمار کے مطابق انتہائی موزوں ہے۔ اِس نئے ماڈل میں کسی سوال کے جواب اور کسی مشاہدے کی وضاحت کیلئے کسی بھی مفروضے کی ضرورت نہیں ہے۔ اِس کتاب میں پیش کردہ ریاضیاتی، سائنسی اور منطقی شواہد کی حقیقت کو تنقیدی جائزے سے بخوبی پرکھا جا سکتا ہے۔ دونوں ماڈلز کا تقابلی جائزہ لینے سے یہ بات مکمل طور کر عیاں ہو جائے گی کہ سورج مرکز ماڈل (Heliocentric) ایک وہم تھا اور اِسکا کوئی سائنسی جواز بھی نہیں تھا۔ اَب ثابت ہو چکا ہے زمین سورج کے گرد نہیں گھومتی بلکہ سورج زمین کے گرد گھومتا ہے۔

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PART - 1

MATHEMATICAL ASSESSMENT OF HELIOCENTRIC MODEL OF SOLAR SYSTEM

CHAPTER 1

1 INTRODUCTION

Since classical times attempts are being made to understand the true nature of the solar system and relative motion of the celestial objects. Man was curious to understand the solar system. Whether the sun revolves around the earth or the earth revolves around the sun? This question had been a matter of debate among philosophers and scientists for centuries. Several theories were proposed successively to describe the relative motion of the sun and the earth (Berger, 2005; Wynn-Williams, 2005). Heraclides (330 BC) was the first one to develop a geocentric model of solar system. Plato, Eudoxus and Aristotle were also in favor of geocentric system. Aristarchus (270 B.C), however, proposed heliocentric theory. Subsequently, a debate was initiated on heliocentric versus geocentric concept of solar system. Many other eminent scientists also contributed towards understanding the solar system. Remarkable was Ptolemy (Claudius Ptolemaeus; 127-145 AD) who strengthened geocentric theory that became popular (Dryeyer, 1953; Fix, 2001; Roy and Clarke, 2003; Weatherly, 2005). It is known as the Ptolemaic system. He tried to prove the central position of the earth in the solar system with certain arguments. Consequently, his geocentric concept remained widely accepted until 15th century. However, Nicolas Copernicus (1473-1543) challenged geocentric doctrine. He proposed heliocentric model. His perception and description of the solar system caused a change in the worldview leading to scientific revolution. Later on significant additions were made in understanding the solar system by Galileo (1564-1642), Tycho Brahe (1546-1601), Johannas Keppler (1571-1630), etc. Newton (1680) discovered the gravity and developed the laws of motion and universal gravitation that further helped to explain the motion of heavenly bodies.

1.1 Geocentric Theory

The geocentric theory described the universe with the earth at its center and put the other celestial bodies in circular orbits around it. It was postulated that heavens revolved

around the earth once every 24 hours while an outer sphere carried the sun around the earth every day. It rotated on an inner sphere about an axis attached to the outer one. This second effect accounted for the sun's yearly transit along the ecliptic, a plane held at a 23.5° angle with respect to the celestial equator (taking the North Star as the North Pole). Because the sun's tilted orbit placed it at different angles relative to the equator at various times of the year, this model provided a natural explanation for the origin of seasons. Three more spheres were required to make the sun's motion consistent with the dates on which the solstices and equinoxes fall. The motion of the moon and the planets were treated in a similar fashion and there were 27 nested spheres in all. It was assumed in geocentric model that all the celestial bodies traveled around the earth with uniform velocity (Jejjala, 2005). However, several problems and complexities were associated with geocentric theory proposed by Claudius Ptolemaeus.

1.2 Heliocentric Theory

Heliocentric Model was proposed lastly by Nicolas Copernicus (Goetz, 1985; Considence, 1968). Nonetheless, certain modifications and improvements were made in the model after the advent of modern science. This model is still accepted as the most plausible scientific explanation of the solar system.

Heliocentric theory places the sun in the center of the system and all other planets revolve around it in circular orbits. According to this theory, the sun is at the center of the universe. East to west daily motions of stars, planets, the moon, and the sun are caused by the rotation of the earth on its axis. Stars are stationary (Ramsey, 2007) and no star rises or sets. All stars just seem to move from east to west. An important characteristic of the stars is that they have relatively fixed positions with respect to each other i.e. the constellations do not change with time. The earth revolves around the sun in circular orbit. This produces the change in constellations observed from one time of year to the next. Relative positions of the sun and the earth in the celestial sphere, as proposed in this theory, are depicted in Fig-1.1.

In heliocentric model, the earth is like a globe of radius 6378.388km (Briggs and Taylor, 1986; Considence, 1968). It spins around its own axis with a speed of about 1600km/s (Halsey, 1979) and completes one rotation in about 23.9345 hours (Briggs and Taylor, 1986). This motion is called rotation and the line around which it turns is called the axis

of rotation. The earth's axis of rotation runs through the North Pole, the center of the earth, and the South Pole. As the earth rotates a given part of it comes into the range of light from the sun (Branley, 2015) for a part of the time (daytime) and then rotates out of that range (night time).

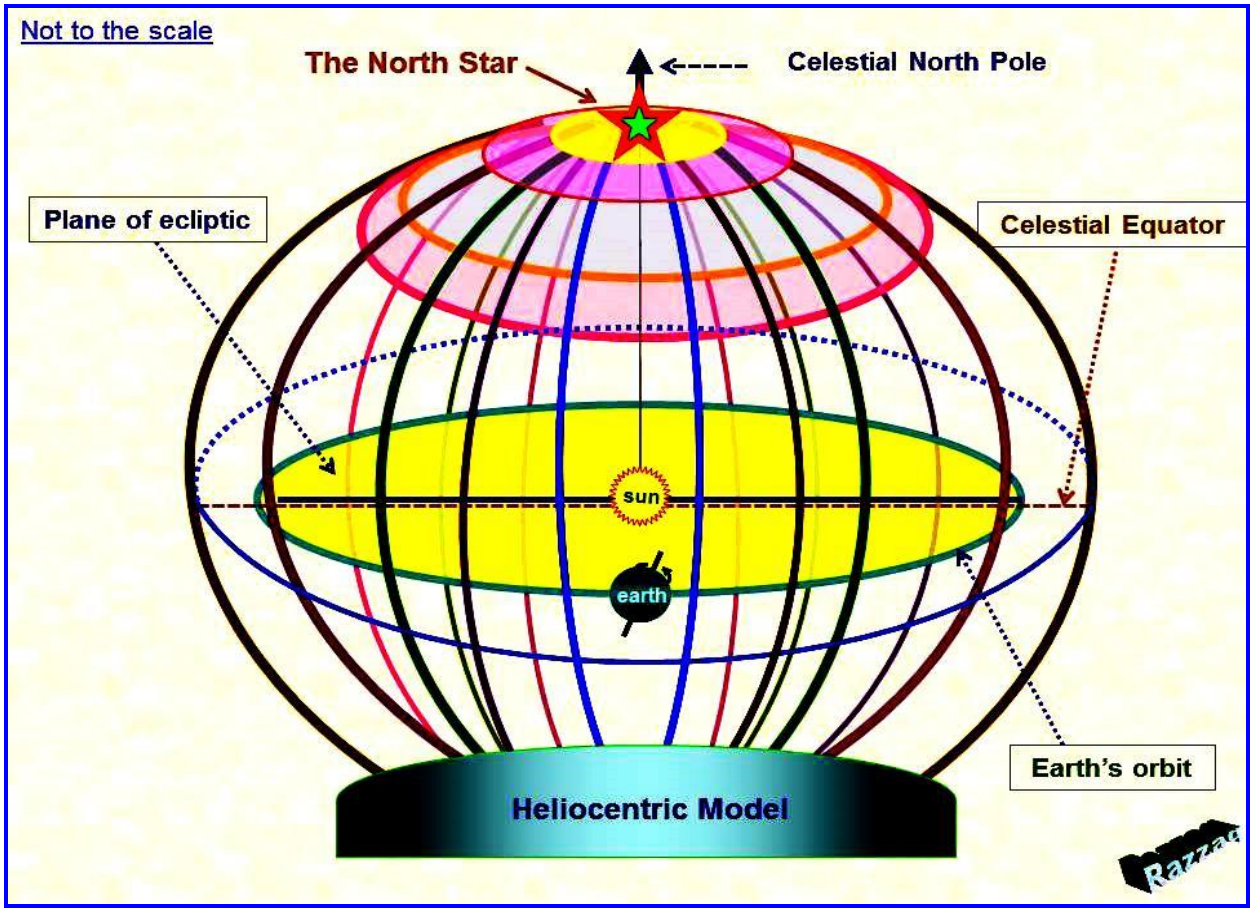

Fig – 1.1 Relative positions of the sun and the earth in celestial sphere in heliocentric model

The earth is a planet, orbiting around the sun (Anderson, 2002; Whitlow, 2001) with a speed of 30km/s (Halsey, 1979) along a roughly circular path with an average radius of 1.4947×10^8km (Briggs and Taylor, 1986; Considence, 1968; ILSC, 1970). This motion is known as orbital revolution. The earth completes one orbital revolution in approximately 365.25days (Briggs and Taylor, 1986; Crystal, 1994). However, the time taken to complete the orbit relative to the stars is not same. The earth takes about 20 minutes more to complete its revolution with respect to the stars (Capderou, 2005). The sun rises in a new constellation on the day of equinox. The difference in revolution periods of the earth relative to the sun and the stars, and rising of the sun in new constellation

was justified by assuming that axis of the earth precesses clockwise under the influence of lunisolar forces (Heath, 1991).

The earth is tilted about 23.45° (Briggs and Taylor, 1986) with respect to the ecliptic. Revolution of the earth around the sun with tilted axis gives four seasons (Wynn-Williams, 2005). The sun is on the celestial equator on September 22/23 (autumnal equinox), farthest south on December 21/22 (winter solstice), back on the equator on March 21/22 (spring equinox) and farthest north on June 21/22 (summer solstice). The earth's axis keeps pointing towards the same stars (Pole Star) throughout its motion in the orbit (Gates, 2003; Kolecki, 2003).

Although heliocentric model is considered the best explanation of the solar system nonetheless several inconceivable complexities associated with this model are against the established facts and cannot be elaborated with the help of scientific principles. Present concept of heliocentric system is not the original one. Some modifications and additions were made in Copernican system. An important element is missing from the present Copernican system. Copernicus assumed perpetual revolving of earth's axis to keep it pointing continuously towards the pole star. Accepting this notion could not justify generation of four seasons, therefore modern astronomers brushed aside this axiom of Copernicus (Steiner, 1921). They assumed as the stars are far away and the axis remains parallel to itself at all positions in the orbit, so it will practically keep pointing to the pole star (Plait, 2002; Rohli and Vega, 2007). However, this assumption is against the principles of geometry. There are several other limitations of heliocentric model which are discussed in this manuscript.

Presently prevailing heliocentric theory asserts immobility of the sun and has not been challenged for about five hundred years. Prudence, indeed necessitates that the concepts long established should be subjected to rigorous scientific criticism to establish their validity or prove otherwise. Denial of the existing concepts of heliocentric theory should stem from valid evidences based on scientific principles, certain definite observations, and logical inferences based on existing facts and realities. An authentic scientific model must fit with the recent data gathered precisely through the most modern scientific techniques and instruments. If the earth revolves around the sun then central position of the sun and non-centric mobile position of the earth must coincide

with the established principles and observed realities. Geometrically and mathematically predicted positions of the earth, the stars and the sun with these values must coincide with the observed values in heliocentric model for its legitimacy. Therefore, heliocentric model of solar system was evaluated mathematically employing the proven scientific principles and observed realities to establish the validity of heliocentric model or to prove otherwise.

Heliocentric model of solar system when subjected to mathematical criticism could not prove its rationale and lead to challenge its validity. In this manuscript mathematical analysis, logical reasoning and scientific deductions using well-known realities and the most recent numerical values have been presented which provide sufficient ground for legitimate refutation of orbital revolution of the earth as perceived in heliocentric model of solar system.

1.3 Questions lacking mathematical and logical answers in heliocentric model

Several questions are there which have no logical and mathematical answers in heliocentric model. Several assumptions have to be made to answer these questions. However, these assumptions cannot be validated logically and mathematically keeping in view the established facts and realities. These questions are enlisted below for perusal and philosophical thinking of the reader to comprehend the flaws of heliocentric model and purpose of writing this manuscript:

1- What is actual time taken by the earth to revolve 360° in the orbit? Whether sidereal year or tropical year?
2- What revolution period (tropical or sidereal) can justify generation of 24 hour day with 23.9345 hour rotation period of the earth?
3- The sun and the stars are assumed stationary but the earth meets the same star earlier during rotation and aligns with to the same star later than the sun during revolution in the orbit. Why?
4- Sidereal year is 1224.51 seconds (about 20 minutes) longer than tropical year. How is this difference created while the sun and stars relative to the earth are stationary?
5- Axial Precession (precession of equator) is considered responsible for 1224.51 seconds difference in tropical and sidereal years. How can axial precession

create this difference? Does the earth fall back in the orbit due to precession and takes more time to reach at its initial position in the orbit? How can this difference be validated mathematically?

6- Circular displacement of observer on the earth causes a change in angle of view of the reference star but circular displacement of the earth in orbit does not change angle of view of the reference star. How is this possible?

7- Tilted axis of the earth always keeps pointing to the pole star throughout the orbital motion. How can this be proved geometrically and logically?

8- Meridians of tilted earth will not have same alignment to the radiation from the sun during autumnal/vernal equinoxes and summer/winter solstices. How is uniform time observed on meridians while the earth revolves in orbit with tilted axis?

9- Why apparent motion of the stars does not correspond with orbital motion of the earth? If the earth revolves in the orbit why the same constellation can be viewed at night in between the observer and the pole star for several months?

10- How celestial and terrestrial axes, equatorial planes and parallels coincide despite tilted axis of the earth and revolution in the orbit?

11- How does the moon orbit the earth that itself orbits the sun? If the moon revolves around the earth due to gravitational pull then what force is responsible for dragging the moon along with the earth in the orbit?

12- When the moon is in between the sun and the earth what is the net gravitational force applied on the moon? What will be the fate of the moon under two different gravitational forces in opposite directions?

13- Altitude and velocity is calculated to put a satellite in orbit with certain period without any consideration to orbital motion of the earth. Why? What force keeps the satellite linked with the earth throughout the orbital motion of the earth?

This manuscript is written to prove scientifically that heliocentric model is incompetent to answer these questions and to present a new model that can provide mathematical and logical answers to all these questions.

CHAPTER 2

2 EARTH'S AXIAL PRECESSION: "REALITY OR MISCONCEPTION"

It has been observed since centuries that:

1- The sun rises in a new constellation on the day of equinox (after each tropical year).

2- Sidereal year is 1224.51 seconds (about 20 minutes) longer than the tropical year.

To validate the observed phenomenon of sun rising in new constellation each year and to justify the difference between the lengths of sidereal and tropical years concept of axial precession was coined. It was assumed that the axis of the earth precesses clockwise so that the equinoctial point i.e. point of intersection of the ecliptic and terrestrial equatorial plane (or celestial equatorial plane) moves clockwise and makes the sun to rise in a new constellation after each tropical year. It has been assumed that earth's axial precession is responsible for the difference in sidereal year and tropical year and rising of the sun in new constellation without any mathematically verification.

Rising of the sun in a new constellation on the day of equinox (Heath, 1991) is well established observation. This phenomenon was attributed to westward shifting of equinoctial point and is called as precession of equinoxes or axial precession. Attraction of the sun and the moon on equatorial bulge of the earth makes the axis to wobble clockwise. Precession of equinoxes has been known since classical times. This astronomical phenomenon was discovered by Hipparchus in 2nd century BC (Heath, 1991; The Columbia E Enc, 2012). Axis of the earth is not stationary but traces out a circle with respect to the fixed stars causing the equinoctial point to move in *antecedentia*. Equator and ecliptic do not intersect each other at the same position. The point of intersection moves from east to west (clockwise) by more than 50 arc-seconds (Daintith, 2008; IERS, 2010) every year while the inclination of poles remains same (Pappalardo et al., 2009). Sidereal year is about 20 minutes longer than tropical year. Clockwise axial precession of the earth is supposed to create difference between sidereal and tropical years (Capderou, 2005). Nonetheless, no mathematical evidence has been provided to verify that the difference between sidereal and tropical years is created due to axial precession. Sidereal day which represents earth's period of rotation with respect to the stars is considered about 0.0084 seconds shorter than the actual

period of rotation (McCarthy, 2004) due to precession of rotational axis of the earth. Presently, use of the term precession of the equator is recommended for this phenomenon (Hilton et al., 2006). It has been related to glacial cycles (Raymo & Huybers, 2008) and rise and fall of civilizations (Cruttenden, 2005). Precession of equinoxes is still controversial among astronomers. Short comings of this theory have been addressed recently (Capitaine et al., 2003). Homann (1999) postulated that theory of precession does not have a proven scientific foundation. Mathematical attempts have also been made to refute this theory (Homann, 2001). The earth precesses relative to the fixed stars outside the solar system but it does not precess relative to the objects within the solar system (Homann, 2004). Therefore, the earth should have non-precessing or fixed axis of rotation (Homann, 2001).

Two theories i.e. lunisolar and binary motion of the sun have been proposed to explain the cause of precession. Binary Research Institute USA has suggested that precession of equinoxes might be the result of binary motion of the sun (Cruttenden & Days, 2004). However, lunisolar explanation is widely accepted. Lunisolar model suggests that axis of the earth exhibits a slow clockwise circular motion. Nicolaus Copernicus first put forth the idea of “wobbling” spin axis. In this wobble motion, the axial tilt of the earth remains constant but the orientation is always changing. Precession of the equinoxes depends on the joint action of the sun and the moon (The Columbia E Enc, 2012) on equatorial bulge of the earth which causes the earth's axis to describe a cone like spinning top. The lunisolar forces produce enough torque to drift the earth’s axis clockwise. Consequently, after a period of approximately 25,770 years (Scofield and Orr, 2011) the earth would have completed one precession cycle. Nonetheless, fundamental flaws and incomprehensible mathematical complexities are associated with this concept. Basic mathematics of axial precession is never presented and discussed to validate this concept. Basic mathematical analysis and implications of clockwise axial precession of the earth are provided first time in this book to elucidate the reality of this astronomical phenomenon.

2.1 Mathematics of axial precession and its implications

It is assumed that axis of the earth describes a clockwise circular motion due to impact of lunisolar forces on the equatorial bulge. Two possibilities for this kind of axial

precession have been proposed. Firstly, the North Pole traces out a precessional circle (Plait, 2002; Seeds and Backman, 2015b; Vincent, 2003) while the South Pole remains fixed. Secondly, the earth's North-South rotation axis i.e. both poles trace out precession circles (McNish, 2013; Seeds & Backman, 2011) while center of the axis remains immobile.

Fashion of precession of North Pole at fixed South Pole i.e. North Pole describing clockwise motion in precessional circle is presented in Fig-2.1. Axial precession occurs at the rate of 50.28792 arc-seconds (IERS, 2010) or 0.0139688667°/annum. Polar diameter of the earth "AB" is 12714 km (Denecke & Carr, 2009) and axis of the earth (AB) is tilted 23.45° relative to the ecliptic. Therefore, radius of precession circle "AO" and circular displacement of North Pole from position "A" to "A1" with yearly precession of 0.0139688667° can be calculated as follows. Consider the right-angle triangle ABO:

i) Radius of precession circle (AO)

Sin θ = perpendicular (AO) ÷ hypotenuse (AB)

θ (ABO) = 23.45°, AB (earth's polar diameter) = 12714 km

Radius of precession circle (AO) = Sin 23.45°X AB = 5059.5189 km

ii) Clockwise circular displacement of North Pole (A-A1)

Angle of precession (θ) = 0.0139688667° or

0.0002438027 radians (2π radians = 360°)

A-A1 = rθ = (0.0002438027 x 5059.5189) = 1.2335 km

The North Pole will trace a circle of radius 5059.5189 km. After one tropical year it will be at position "A1", 1.2335 km away from its initial position. Thus, the North Pole will be drifting backward at the rate of 0.0139688667°per annum. This clockwise motion of the axis is called axial precession. Consequently, the equinoctial point will be moving westward thereby making the sun to rise in different constellation on the day of equinox (Heath, 1991).

Precession of the axis at both the poles with static center of the axis is depicted in Fig-2.2. Both North Pole and South Pole will be making angle of 23.45° with the perpendicular on the ecliptic. After one tropical year North Pole will be at "A1" while South Pole will be at position "B1". When the North Pole goes to position "C" the South Pole will be at "D".

Consider the right-angle triangle AEO. Using sine formula radius of precession circle (AO) and circular displacement of North Pole from "A" to "A1" can be calculated as follows:

iii) Radius of precession circle (AO)

Sin θ = perpendicular (AO) ÷ hypotenuse (AE)

θ (AEO) = 23.45°

AE = 6357 km (polar radius of the earth)

AO = Sin 23.45° x AE = 2529.7594 km

iv) Clockwise circular displacement of North Pole (A-A1)

Angle of precession (θ) = 0.0139688667° or 0.0002438027 radians

A-A1 = rθ = 2529.7594 x 0.0002438027 = 0.6168 km

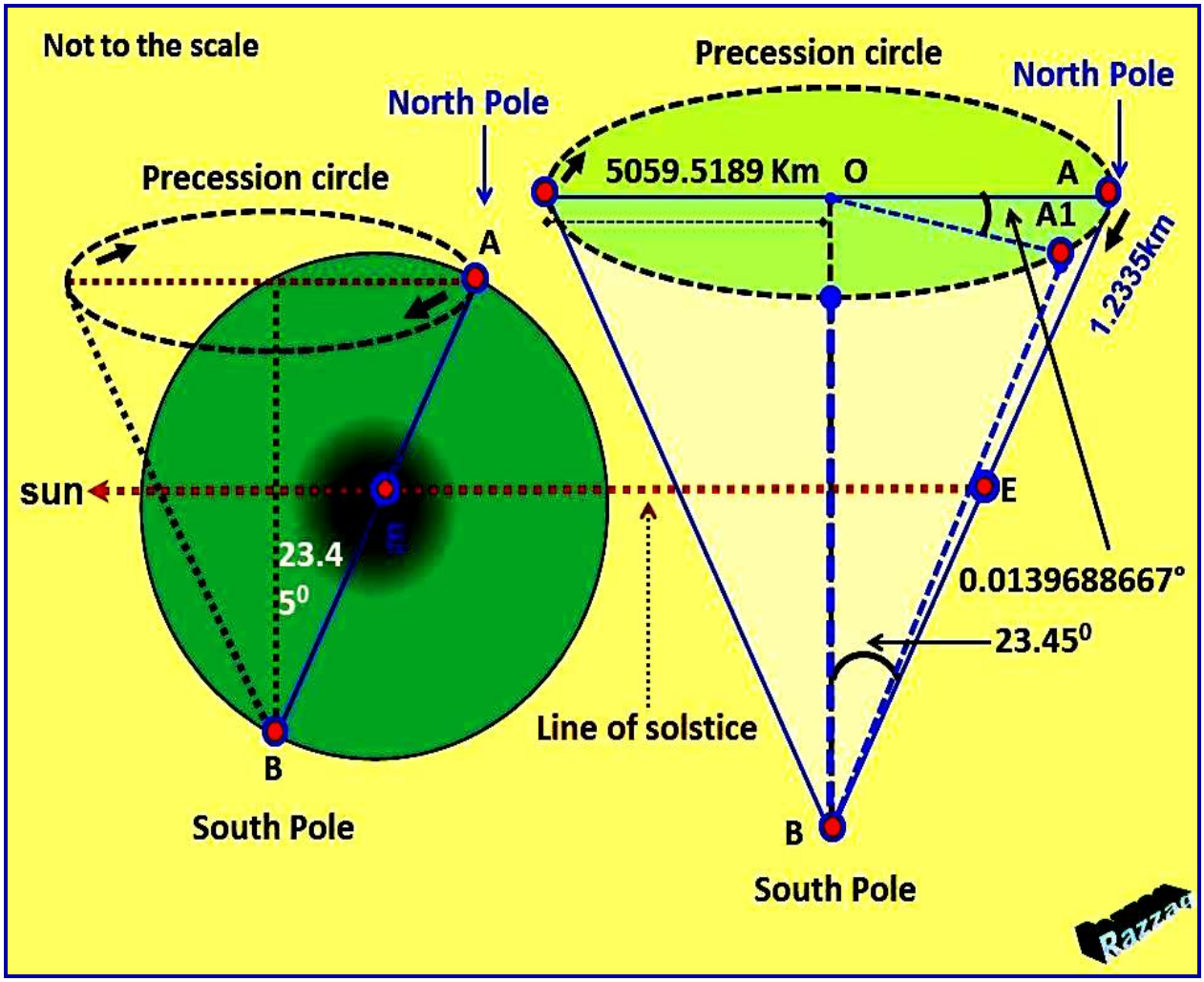

Fig – 2.1: Precession of North Pole with fixed South Pole. **AB:** Initial position of tilted axis of the earth. **O:** Center of precession circle. **A1B**: Position of axis with 0.01396° precession of North Pole after one tropical year. **E:** Center of the axis.

As the triangles AEO and BEO1 are isosceles so both North Pole and South Pole will trace circles of radius 2529.7594 km. Annual precession will displace both the poles 0.6168 km from their initial positions. This is equivalent to 0.0139688667° clockwise precession of earth's axis. Thus, both the poles will drift backward each year resulting in precession of equinoxes.

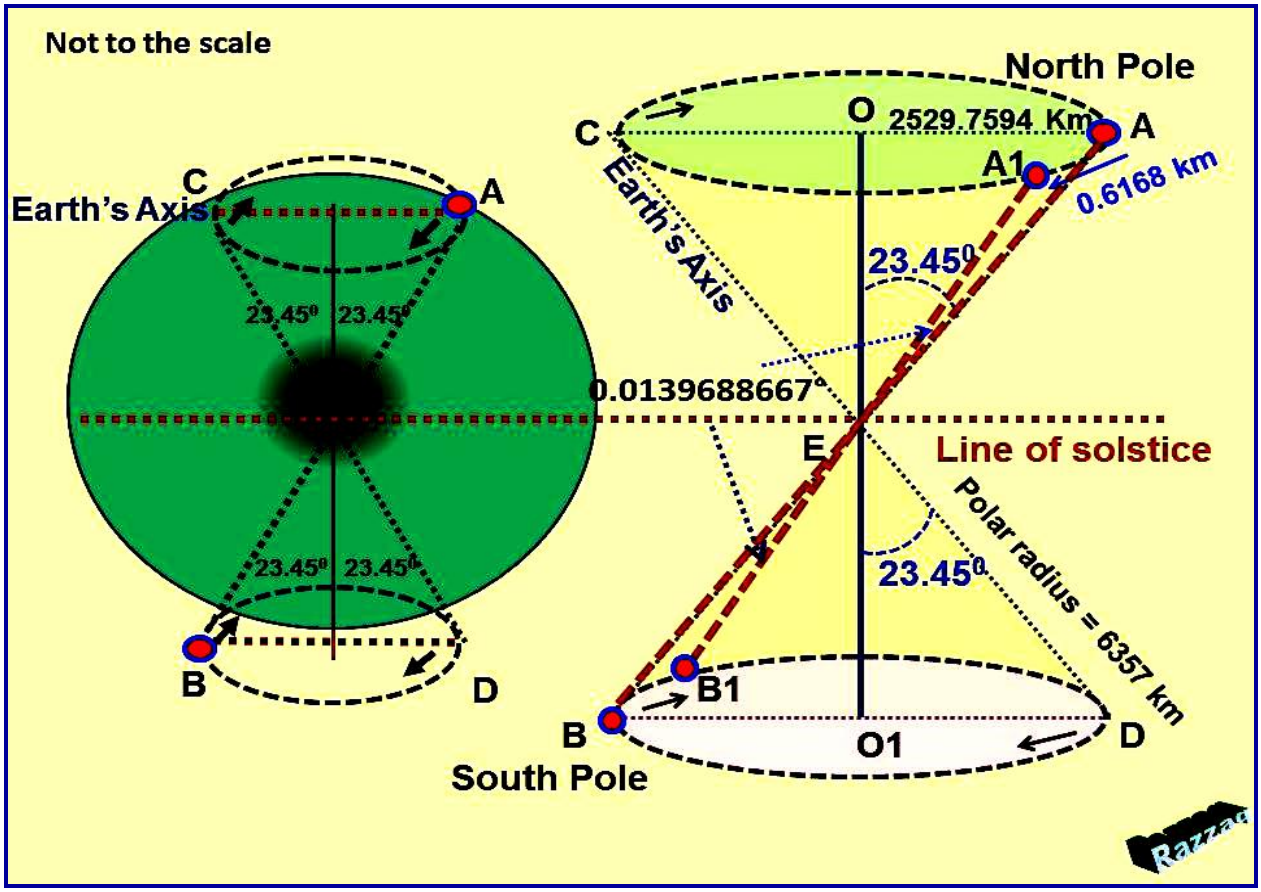

Fig – 2.2: Precession of axis at both the poles. **AB:** Initial position of tilted axis of the earth. **O & O1:** Centers of precession circles for North Pole and South Pole, respectively. **E:** Center of the axis. **AE** and **BE:** Polar radius of the earth. **A1, C** and **B1, D:** Different positions of North Pole and South Pole, respectively, in precession circle.

Precession of axis at North Pole with fixed South Pole or precession of North Pole and South Pole with fixed center will have almost similar implications. Implications for precessing North Pole with non-precessing fixed South Pole are described in the following text.

Clockwise motion of earth's axis in precession circle will cause the equinoctial point (point of intersection of equatorial plane and the ecliptic) to shift clockwise. Let the axis of the earth be at position "AO" in precession circle and the equinoctial point at "X" (Fig-2.3). After one tropical year the position of the axis will be "BO" and the equinoctial point

will shift to position “Y”. This clockwise shifting of equinoctial point by about 50.28792 arc-seconds (IERS, 2014) causes the sun to rise in different constellation on the day of equinox (Heath, 1991). Because the terrestrial equatorial plane coincides with celestial equatorial plane (Barbieri. 2006) therefore the sun appears in new constellation every tropical year. Consequently, axial precession well justifies rising of the sun in new constellation on the day of equinox. However, there are some other associated complexities which have to be rationalized with the concept of earth’s axial precession.

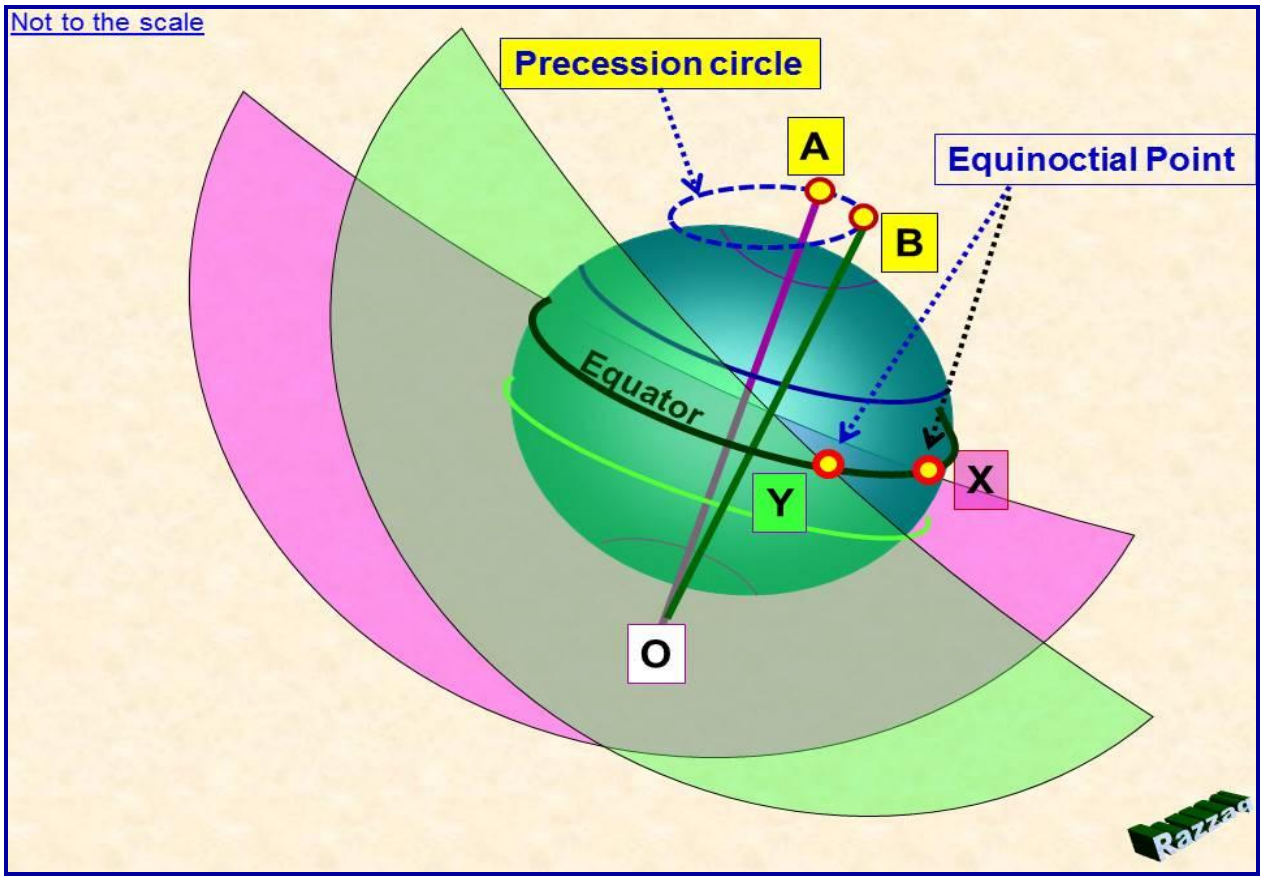

Fig – 2.3: Earth’s axial precession and clockwise shift of equinoctial point. **AO:** Initial position of axis. **X:** Initial position of equinoctial point. **BO:** Position of axis after tropical year. **Y:** Position of equinoctial point with precession.

2.2 Axial precession and revolution period of the earth

Tropical period of revolution or tropical year is revolution period of the earth relative to the sun. Whereas, sidereal year or sidereal period of revolution is the time required for the earth to complete one orbital revolution relative to the stars or the time in which the earth, the sun and the reference star align again. Question arises what is true revolution period of the earth. How much time the earth takes to revolve 360°? Whether it is tropical year or sidereal year? No clear answer but contradictory statements are

available in literature. It is reported that the earth completes exactly one orbit around the sun in sidereal year (Strobel, 2004). Erickson (2010) and Fenn (2012) have stated that the earth completes 360° revolution around the sun in tropical year. This confusion has been created because of the assumption of axial precession. Axial precession necessitates that the earth must revolve 360° in sidereal year.

Length of sidereal year is equal to 365d 6h 9min 9.76s or 31558149.76 seconds whereas length of tropical years is 365d 5h 48min 45.25s or 31556925.25 seconds (Capderou, 2005; IERS, 2010). Sidereal year is more than 20 minutes (1224.51 seconds) longer than tropical year. This difference is attributed to precession of equinoxes. It is the precession of equinoxes that causes a decrease in length of tropical year otherwise there would be no difference between sidereal and tropical years (Capderou, 2005; Kelley & Milone, 2011; Snodgrass, 2012; Yang, 2007). The earth travels little less than 360° in tropical year due to axial precession whereas it makes one complete revolution (360°) in sidereal year (Punmia et al., 2005; Seethaler, 2011). If concept of axial precession is valid and the earth completes 360° revolution in sidereal year then an observer on the earth must come to same position relative to the sun after every discrete multiple of 24 hours with axial rotation throughout the orbit. Therefore, mathematical analysis and logical investigation to help establish the validity of sidereal year as true revolution period of the earth is crucial.

Let us suppose that the earth at position “X” in orbit is in line with a distant star “S” (Fig-2.4). If the earth completes 360° revolution around the sun in sidereal year then it will be at position “Y” in orbit after tropical year. Alternately if the earth comes to position “X” again after revolving 360° in tropical year then it will go to position “Z” after sidereal year. The earth completes one rotation (360°) in one sidereal day. Observer on the earth will come to the same position with respect to the reference star after the earth rotates 360° in sidereal day or 86164.09053083288 seconds (IERS, 2014). However, the observer should come to the same position relative to the sun after every 24 hours throughout the revolution of the earth in orbit. Therefore, it can be hypothesized that:

> *“If the earth traverses 360° in sidereal year then the observer on the earth should be at the same position relative to the sun after discrete number of days (every 24 hours) with 86164.09053083288 seconds rotation period of the earth throughout the orbital revolution”*.

Suppose the earth is at position “W” in the orbit (Fig-2.5). An observer at position “a” on the earth is facing a reference star indicated by the arrow “p” and is right opposite to the sun at 12.00 o’clock midnight. The earth reaches the same position "W" after 31558149.76 seconds, the length of sidereal year (IERS, 2014) with 360° revolution in orbit and aligns again with the reference star. Let us consider the situation after 365 days.

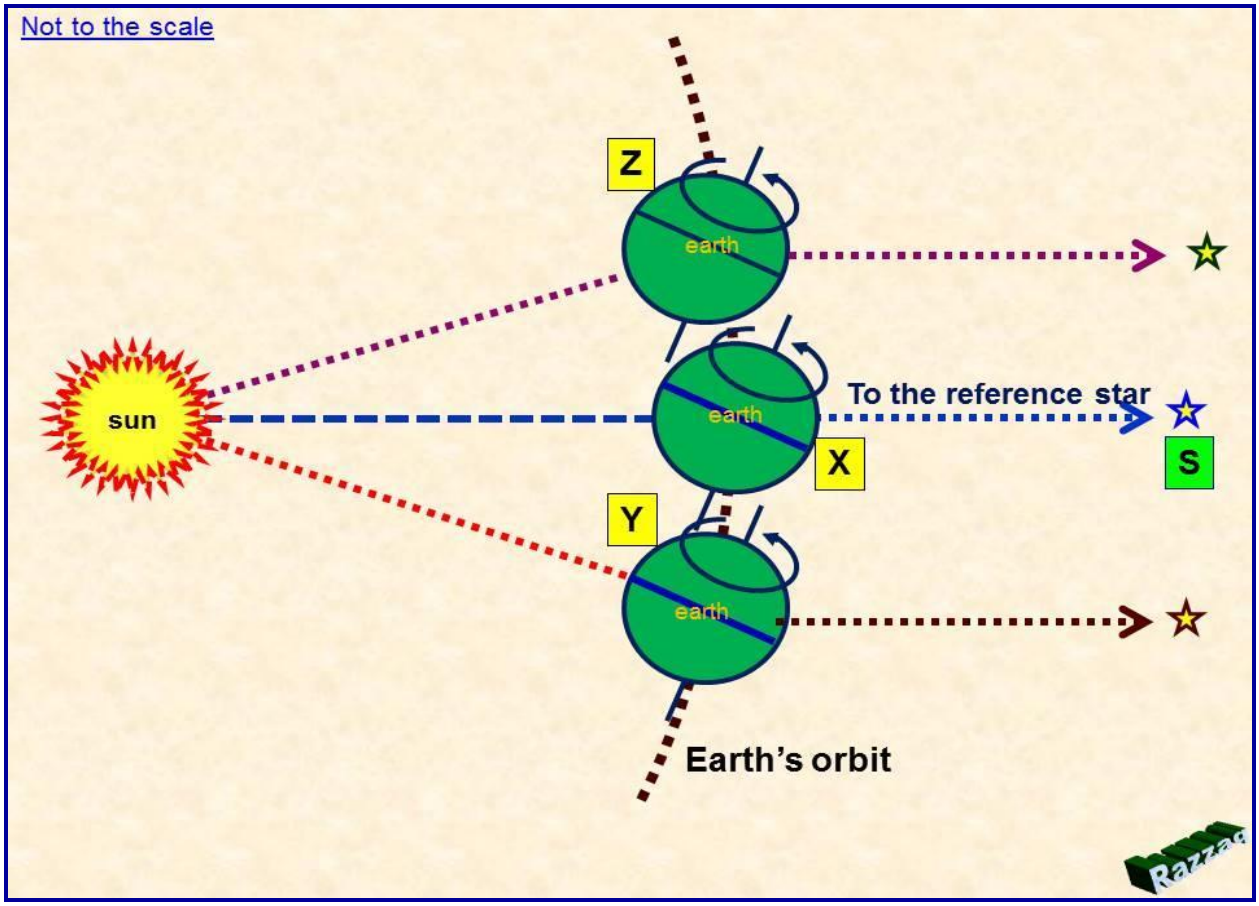

Fig – 2.4: Revolution period and position of the earth in orbit. **X:** Initial position and position of the earth after 360° revolution, **Y:** Position of the earth after tropical year if it completes 360° revolution in sidereal year, **Z:** Position of the earth after sidereal year if it completes 360° revolution in tropical year, **S:** The reference star.

Position of the observer “b” and that of the earth “X” after 365 days with axial rotation and orbital revolution of the earth is calculated below:

i) Revolution of the earth in 365 days

Revolution of earth in sidereal year (31558149.76 s) = 360°

Revolution of earth in 365 days (31536000 s) =

{(360 ÷ 31558149.76) x 31536000} = 359.747326327410°

ii) Rotation of the earth in 365 days

Rotation period of the earth = 86164.0905 3083288 s

Rotation in 365 days (31536000 s) =

{(360 ÷ 86164.09053083288) x 31536000} =

131759.761288694472° or 365 complete rotations + 359.761288694473°

So, the earth will have revolved 359.747326327410° in 365 days and rotated 359.761288694473° after completing 365 rotations. Consequently, the observer will be at position "b" on the earth at position "X" and will not be right opposite to the sun for midnight time. He should be at position "c" right opposite to the sun to experience midnight time after 365 days. There will be difference of 0.013962367063° between the actual position of the observer and the expected position for being right opposite to the sun for midnight time.

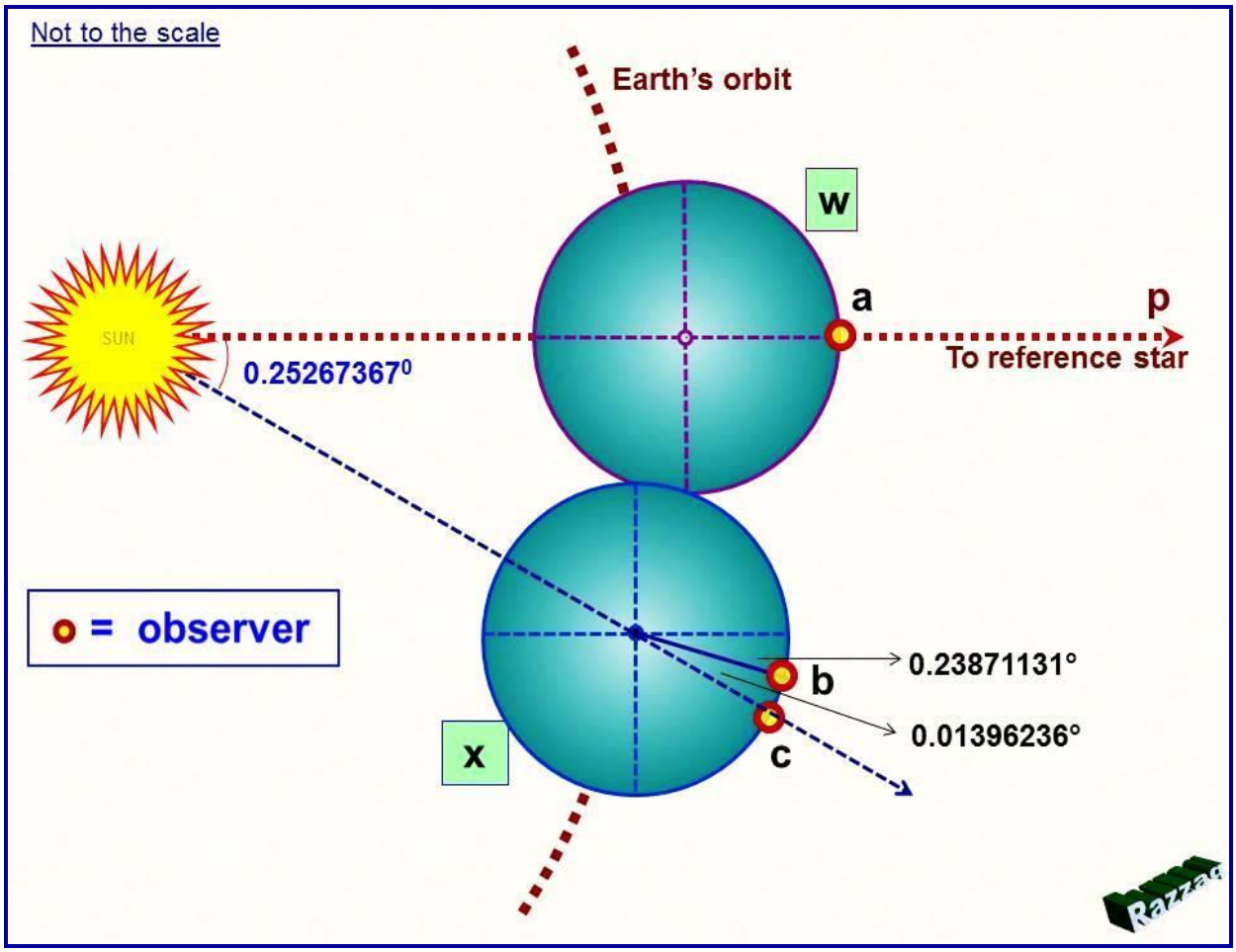

Fig – 2.5: Sidereal period of revolution, position of the earth and observer after 365 days. **W:** Initial position of the earth in orbit, **a:** Position of observer on earth opposite to the sun at midnight, **p:** Arrow pointing to the reference star, **X:** Position of the earth after 365 days, **b:** Position of observer after 365 days, **c:** Expected position of observer to be right opposite to the sun for midnight time.

Therefore, contrary to the above hypothesis the observer will not be right opposite to the sun to experience midnight time if the earth revolves 360° in sidereal year. Hence it is inferred that sidereal year is not true period of revolution of the earth. Nonetheless, the observer actually experiences midnight time after every discrete number of days. As a result, the earth does not complete 360° revolution in sidereal year. Therefore, sidereal year cannot be regarded as true revolution period of the earth because it lacks mathematical substantiation.

Alternately, it can be assumed that tropical year is true period of revolution of the earth as frequently reported in literature (Bowditch, 2004; Briggs and Taylor, 1986; Considence, 1968; Degani, 1976; Erickson, 2010 and Fenn, 2012). Then, the observer on earth should be at same position with respect to the sun after discrete number of days with earth's sidereal rotation period of 86164.09053083288 seconds (IERS, 2014).

Suppose an observer on the earth at position "a", the earth is at position "w" in the orbit and arrow "p" points to a reference star "s" (Fig-2.6). The earth after revolving 360° will reach to position "w" again after 31556925.25 seconds, the length of tropical year (IERS, 2014). Predicted position of the observer on earth after solar year (365 days) and that of earth in orbit after 365 days and sidereal year is calculated below:

i) Revolution of the earth in 365 days
Revolution the earth in tropical year (31556925.25 s) = 360°
Revolution of the earth in 365 days (31536000 s) =
{(360 ÷ 31556925.25) x 31536000} = 359.7612856784898°

ii) Rotation of the earth in 365 days

Rotation of the earth in 365 days (31536000 s)
= {(360° ÷ 86164.09053083288) x 31536000}
= 131759.761288694472° or 365 complete rotations + 359.76128869447°

iii) Revolution of the earth in sidereal year (31558149.76 s)

= 360.013969155629°

The observer with 365 complete rotations + 359.76128869447° rotation of the earth will be at position "b" while the earth will have revolved 359.7612856784898° in solar year. Consequently the observer will be right opposite to the sun and experience midnight time. Hence, tropical year seems to be the true period for 360° revolution of the earth in orbit. The earth completes 360° revolution in tropical year and goes to its initial position "w" in the orbit after tropical year. After revolving 360.013969155629° the earth will

reach to position “y” in sidereal year but it will not be aligned with the reference star “s” at this position in the orbit. The earth can be aligned with the reference star after sidereal year if the star is at a position arrow “q” points to or the earth is at position ‘w”.

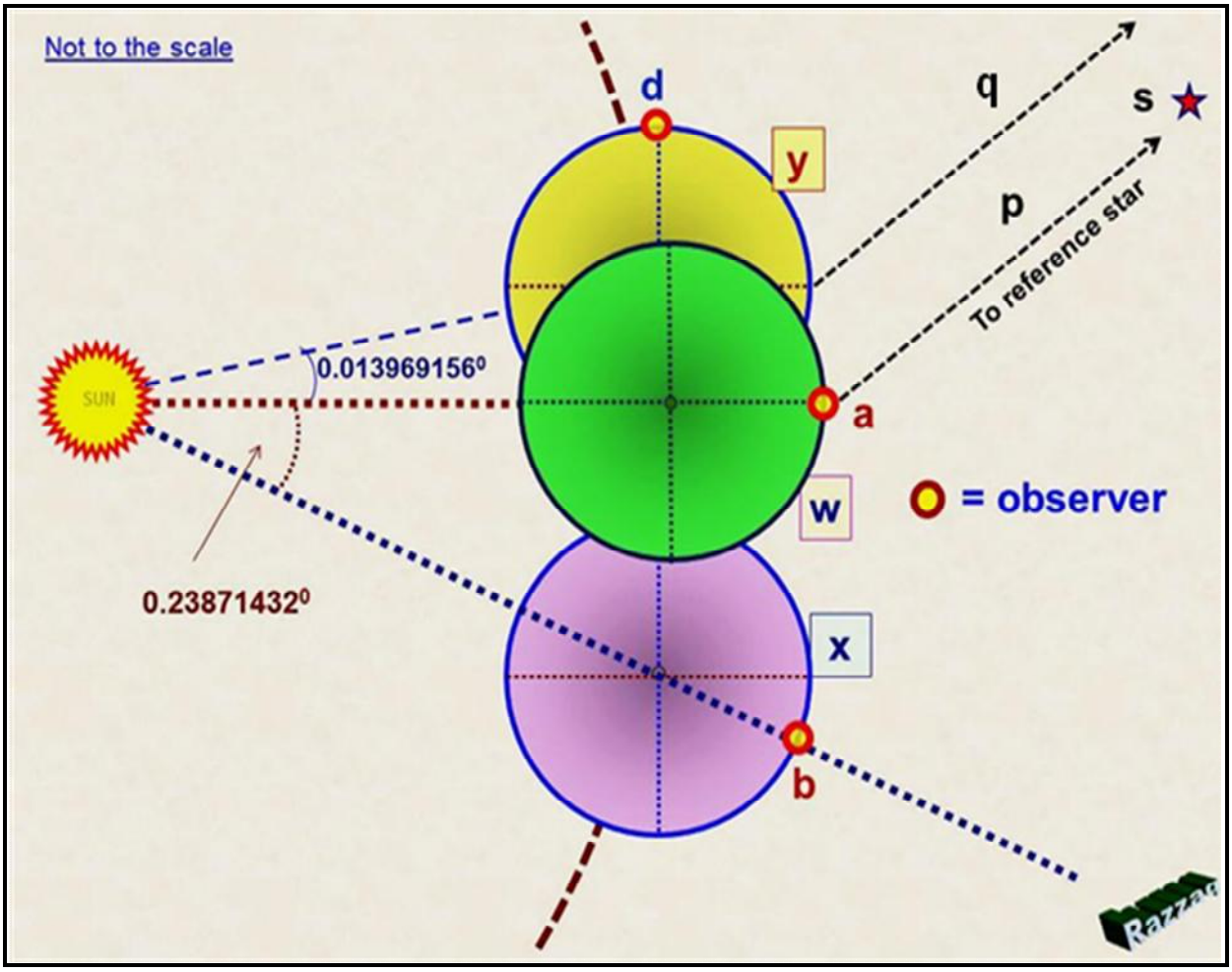

Fig – 2.6: Tropical period of revolution, position of observer and the earth after solar year, tropical year and sidereal year, **W:** Initial position of the earth in orbit, **a:** Position of observer on the earth opposite to the sun at midnight, **p:** Arrow pointing to reference star, **X-** Position of the earth after solar year, **b:** Position of observer after 365 days, **y:** Position of the earth after sidereal year, **q:** Arrow parallel to “**p**”.

Finally, it may be inferred that:

a - If the earth revolves 360° in sidereal year with 86164.09053083288 seconds rotation period, the earth will align with the same star after sidereal year but the observer will not be right opposite to the sun after discrete number of days to experience midnight time. Therefore, sidereal year cannot be regarded as true period of revolution of the earth because it lacks mathematical validation.

b - If the earth revolves 360° in tropical year with 86164.09053083288 seconds rotation period the observer will be right opposite to the sun after discrete number of days to

experience midnight time. The earth will also align with the same stationary star after 360° revolution. So there should be no difference between the lengths of sidereal and tropical years. Additionally, there will be no need for the assumption of axial precession as well.

Nonetheless, the observed fact is that observer on earth reaches to the same position relative to the sun after every multiple of 24 hours (discrete number of days) and the earth aligns with the reference star after sidereal year that is longer than the tropical year. However, these observed facts do not mathematically and logically conform to sidereal year or tropical year taken as revolution period of the earth. Consequently, if sidereal year is not the true period of revolution of the earth then the theory of precession of equinoxes shall stand invalid. Concept of precession of equinoxes cannot be rationalized mathematically. As a result, validity of earth's axial precession becomes doubtful as pointed out by Homann (2001) and Cruttenden (2005). Furthermore, it becomes evident that heliocentric model has several associated mathematical limitations.

2.3 Axial precession and discrepancy between sidereal and tropical years

Tropical year or earth's tropical period of revolution may be defined as "the time between successive passages of the sun through the same point on the ecliptic" (McCarthy and Seidelmann, 2009) or "the interval between successive occurrences of vernal (or autumnal) equinoxes or between successive winter (or summer) solstices" (Davidson and Aldersmith, 1992; Vogel and Dux, 2010) and is equal to 365d 5h 48min 45.25s (Capderou, 2005; IERS, 2010). The earth travels little less than 360° in tropical year due to axial precession whereas it makes one complete revolution (360°) in sidereal year (Punmia et al., 2005; Seethaler, 2011). Sidereal year or sidereal period of revolution is the time required for the earth to complete the orbit around the sun relative to the stars or the time in which the earth, the sun and the reference star align again (Capderou, 2005; Kelley & Milone, 2011; Silen, 2010) and is equal to 365d 6h 9min 9.76s (IERS, 2010). Sidereal year is 1224.51 seconds longer than tropical year. Earth's axial precession is considered responsible for this difference (Capderou, 2005; Snodgrass, 2012; Yang, 2007). In the absence of axial precession the tropical and

sidereal years would be identical (Kelley and Milone, 2011). Thereupon, it can be hypothesized that:

> ***"After one tropical period of revolution axial precession should take the earth to a point in the orbit from where it should revolve more for 1224.51 seconds to align with the sun and the reference star so as to make one complete revolution (360°) in sidereal year"*.**

Let the earth be at position "M" in the orbit on the line joining the sun and the reference star (Fig-2.7) to be called sun-star line in the subsequent text. The earth should be at position "N" in the orbit after tropical period of revolution due to precession. Angle the earth needs to revolve to reach its initial position "M" from "N", the position after tropical year can be calculated as below:

i) Revolution of the earth in tropical year
Length of sidereal year = 365d 6 h 9min 9.76 s or 31558149.76 s
Length of tropical year = 365 d 5 h 48 min 45.25 s or 31556925.25 s
The revolution of the earth in sidereal year = 360°
Revolution of the earth in tropical year =
{(360 ÷ 31558149.76) x 31556925.25} = 359.9860313864°

ii) Angle the earth needs to revolve to complete the orbit "A"
= 360 - 359.9860313864 = 0.0139686136° (50.287009 arc-seconds)

This means that the earth should revolve 0.0139686136° more in the orbit to justify a difference of 1224.51 seconds between sidereal and tropical years. This is almost equal to the reported value of annual precession 50.27 or 0.0139638888° (Daintith, 2008) and 50.28792 arc seconds or 0.0139688667° (IERS, 2010). Thus the earth should be at position "N" in the orbit after tropical year as presented in Fig-2.7. Circular distance the earth needs to travel to reach at its original location in the orbit "M" from "N" may be calculated with the help of triangle MNO as follows:

iii) Circular distance from N to M
MO (r) = 1.5 x 10^8 km (distance of the earth from the sun)
Angle MON (θ) = 0.0139686136° (0.0002438798 radians)
Circular distance from N to M = rθ = 36581.97 km

Therefore, the earth at position "N" will be 36581.97 km away from its initial position in the orbit "M" after one tropical year. It needs to traverse this distance (or revolve 0.0139686136° relative to the sun) from "N" to "M" in 1224.51 seconds to complete 360° revolution. As axial precession is considered responsible for discrepancy between

sidereal and tropical years (Kelley & Milone, 2011; Yang, 2007) so the axial precession must mathematically substantiate 36581.97 km (or 0.0139686136° relative to the sun) falling back of earth in the orbit to justify the difference between the lengths of sidereal and tropical years.

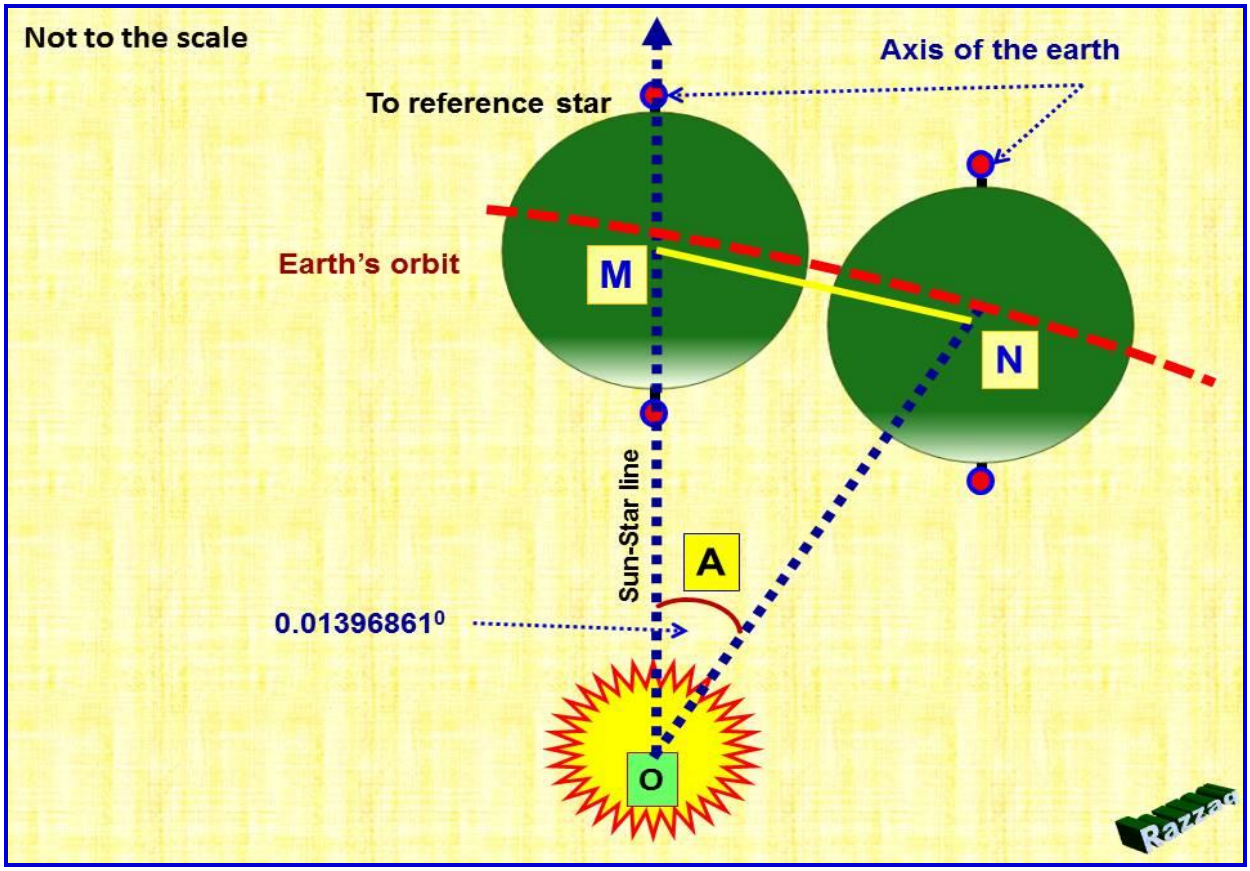

Fig – 2.7: Revolution of the earth and precession. **X:** Initial position of the earth in the orbit. **Y:** Expected position of the earth in the orbit with precession after one tropical year. **A:** Angle the earth needs to revolve to reach sun-star line. **MO & NO:** Average distance of the earth from the sun.

Let us suppose that the earth is on the sun-star line in the orbit during winter solstice. Earth's axis (AB) tilted 23.45° away from the perpendicular opposite to the sun will be in line with the sun-star line at this point as shown in (Fig-2.8 a & b). After one tropical year the North Pole will be at position "A1" with an axial precession of 50.28792 arc seconds or 0.0139688667° (IERS, 2010). Displacement of the North Pole (A1D) from the sun-star line may be calculated with the help of the right triangle A1OD (Fig-2.8b):

iv) Displacement of the North Pole from sun-star line (A1D)

A1O (radius of precession circle) = 5059.5189 km (see section 2.1, equation - i)

Angle A1OD (θ) = 0.0139688667° (reported yearly precession, IERS, 2014)

Sin θ = perpendicular / hypotenuse (A1D/A1O)

A1D = Sin 0.0139688667° x 5059.5189 = 1.2335 km

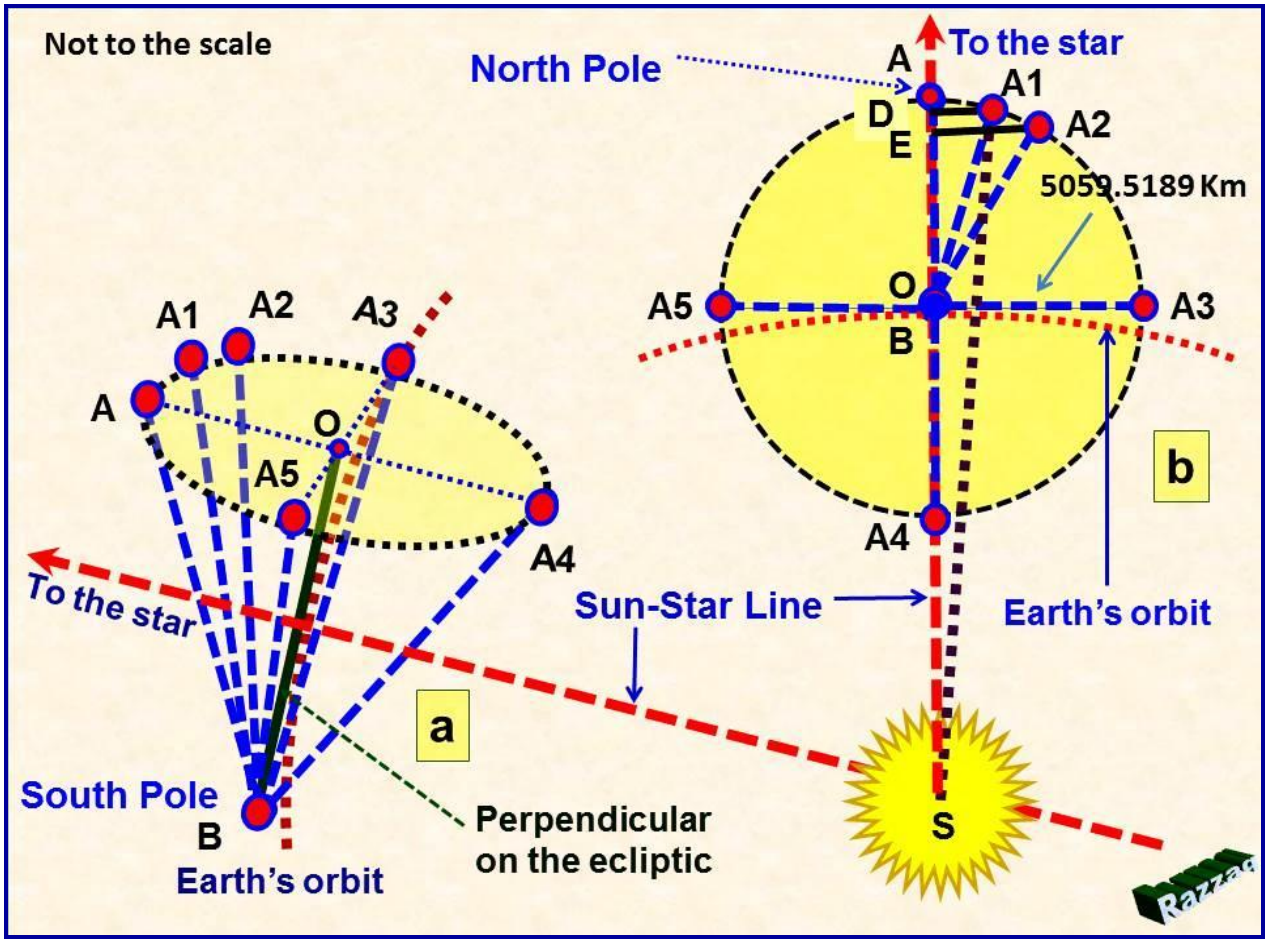

Fig – 2.8: Side and plane view of earth's axis with different degrees of axial precession. **a:** Side view, **b:** Plane view. **AB:** Initial position of the axis. **A: I**nitial position of North Pole, **B:** South pole, **A1, A2, A3, A4** and **A5:** positions of North Pole in precession circle with 0.01396861°, 0.02793722°, 90°,180°, and 270° axial precession, respectively. **O:** Center of precession circle. **AO:** Radius of precession circle. **A1D & A2E:** Perpendiculars on **AO** from **A1** and **A2**, respectively, **S:** Center of the sun.

Thus, the axial precession after one tropical year will displace the North Pole (not the earth) by 1.2335 km from the sun-star line. Let us suppose that 1.2335 km is the displacement of the earth in orbit due to precession. The earth revolves anti-clockwise in the orbit with speed of about 30km/s. It just needs 0.04111667 seconds (1.2335 ÷ 30 = 0.04111667) to take the earth to the sun-star line. Therefore, the earth does not fall back 36581.97 km in the orbit due to axial precession to create a difference of 1224.51 seconds between sidereal and tropical years. Subsequently, there is no legitimate reason to accept the above said hypothesis.

Let us see how much might be the angular displacement of the North Pole relative to the sun induced by earth's axial precession after one tropical year. Angular displacement of the North Pole from "A" to "A1" with respect to the sun may be calculated by considering the triangle A1SD (Fig-2.8b) as follows:

v) Angular displacement (θ) of the North Pole relative to the sun (angle A1SD)

A1S = 1.5 x 10^8 km (distance of the earth from the sun)

A1D = 1.2335 km (see the previous equation - iv)

Sin θ = A1D/A1S = 1.2335 /1.5 x 10^8

θ = Sin $^{-1}$ [1.2335 /1.5 x 10^8] = 4.7116 x 10^{-7} degrees

The angular displacement of earth's North Pole in the orbit relative to the sun due to axial precession will be almost zero and hence there will be no probability of earth or North Pole to be at mathematically expected position in the orbit i.e. 36581.97 km away from its initial position or 0.0139688667° relative to the sun even if axial precession is assumed true. Consequently, it becomes evident that clockwise axial precession of 0.0139688667° in precession circle after one tropical year does not conform to the expected position of the earth in the orbit to justify the difference of 1224.51 seconds between sidereal and tropical years. Consequently above said hypothesis cannot be accepted. Axial precession of 0.0139688667° after one tropical year cannot take the earth to the point in the orbit from where it should take 1224.51 seconds to come on the sun-star line again so as to complete sidereal year. Hence the concept of axial precession is not legitimate and mathematically valid.

How the clockwise slow wobbling motion of axis causes the earth to fall back by 36581.97 km in the orbit equivalent to 0.0139688667° relative to the center of the sun is beyond imagination and mathematically incomprehensible concept. So, the notion of axial precession, assumed to create difference between sidereal and tropical years (Capderou, 2005; Snodgrass, 2012; Yang, 2007) lacks mathematical substantiation and absolutely has no possibility to be illustrated diagrammatically.

2.4 Axial precession and length of sidereal year at poles

Sidereal period of revolution is equal to 365d 6h 9min 9.76s (31558149.76s) or 365.25635995 days (IERS, 2010). As the axis of the earth returns to the same position on the sun-star line after every sidereal year therefore, the length of sidereal year should be same whether measured at South Pole or North Pole. Variation in length of sidereal year measured at North Pole and South Pole has never be recorded and reported. So, it can be hypothesized that:

"Axial precession must correspond mathematically to same length of sidereal year at both poles of the earth".

The North Pole from its initial position “A” will move to “A1”, “A2” and “A3” with 0.0139688667°, 0.02793722° and 90° axial precession, respectively (revisit Fig-2.8b). Displacement of the North Pole from the sun-star line at these positions may be calculated as below:

i) A1D = 1.2335 km (already calculated; see equation iv, section 2.3)
ii) A2E (displacement of North Pole with precession of 0.02793722°
A2O = radius of precession circle = 5059.5189 km (see equation i, section 2.1)
A2E = Sin 0.02793722° x 5059.5189 = 2.4670 km (from triangle A2EO)
iii) A3O = ?, When the axial precession equals 90° North Pole will be at A3
A3O = 5059.5189 km (radius of precession circle)

Therefore, when the South Pole meets the sun-star line the North Pole of the tilted axis will be 1.2335km, 2.4670km and 5059.5189km away from the sun-star line with precession of 0.0139688667°, 0.02793722° and 90°, respectively. So, the North Pole should take 0.041117s (1.2345 ÷ 30), 0.082233s (2.4670 ÷ 30) and 168.65121s (5059.5189 ÷ 30) more, respectively to reach the sun-star line than that of the South Pole, if this is the displacement of the earth in the orbit. North Pole and South Pole align with the sun-star line simultaneously with precession of 180°, thereby completing the sidereal revolution at same time. North Pole will be at position A5 after precession of 270° and the axis will be leaning towards the left side of the vertical relative to the sun (revisit Fig-2.8a & b). So North Pole will be 5059.5189km ahead of South Pole in meeting the sun-star line making sidereal period shorter by 168.65121s at North Pole. Consequently, axial precession must produce difference between the lengths of sidereal year at North Pole and South Pole continuously fluctuating between zero and ± 168.65121 seconds. Hence, it can be inferred that if axial precession occurs then there must be noticeable difference in the lengths of sidereal period at North Pole and South Pole. Nonetheless no difference in length of sidereal year at North Pole and South Pole has been noticed and reported so far. Therefore, axial precession does not correspond mathematically to equal length of sidereal year at both the poles and is inconsistent with the above said hypothesis.

Phenomenon of precession was discovered in 2nd century BC (Heath, 1991). About 2200 years have been passed since then. Let us assume that the axial precession just started in 2nd century BC. So, a difference of more than 90 seconds (0.041116 x 2200) might be observed presently between the lengths of sidereal year at North Pole and

South Pole. However, discrepancy between lengths of sidereal year for North Pole and South Pole is never detected and reported. Almost same length of sidereal year has been stated since 1812 (Woodhouse, 1812) to 2013 (Whenfield, 2013). Therefore, idea of axial precession has no mathematical relationship with same length of sidereal year at both the poles and seems invalid.

2.5 Axial precession and concept of sidereal year

Sidereal year is the time that elapses between the instant when earth's center crosses the straight line passing from the center of the sun to a distant star (sun-star line) and the next instant when earth's center crosses the line (Ball, 2013; Silen, 2010). Reconsider the earth on the sun-star line during winter solstice in the orbit. Earth's axis (AB) tilted 23.45° away from the perpendicular opposite to the sun is in line with the sun-star line at this point (revisit Fig-2.8a & b). Therefore, it can be hypothesized that:

> *"After every sidereal period of revolution axis of the earth should return to its original position on the sun-star line despite axial precession to justify the concept of sidereal year".*

It is assumed that lunisolar forces produce torque causing the axis of the earth to exhibit slow clockwise conical motion about the vertical to the ecliptic drifting the North Pole back by about 0.01396861° after each tropical year (The Columbia E Enc, 2012). The North Pole will be at position "A1" "A2" and "A3" (Fig-2.8a & b) with axial precession of 0.01396861°, 0.02793722° and 90°, respectively. The North Pole will be 1.2335, 2.4670, 5059.5189km on right side of the sun-star line with respect to the sun. After precession of 180° the North Pole at position "A4" will be in line with the sun-star line again. Precession of 270° at position "A5" will take the North Pole 5059.5189km to the left side of the sun-star line. The axis will not be in line with the sun-star line. Axis will correspond to its original position only with precession of 180° (position A4B) and 0° or 360° (position AB). Consequently, it can be inferred that with axial precession the earth's axis does not return to the same position after sidereal period conflicting with the hypothesis. The position of the axis will be changing continuously after every sidereal year and it will not match to its original position on sun-star line if there is axial precession except at the point of 180° precession. Therefore, notion of axial precession does not conform to the established concept of sidereal year (Ball, 2013; Barbour, 2001) and makes this concept more complicated.

2.6 Axial precession and recurrence of seasons

Revolution of the earth around the sun with tilted axis gives four seasons (Butz, 2002). Northern and southern hemispheres experience opposite seasons. When the North Pole is oriented toward the sun the South Pole is oriented away and vice versa (Craghan, 2003). It is an established fact since centuries that the same season recurs after 365.24219 days (tropical year) or 31556925.25 seconds (Angelo, 2014; Meeus and Danby, 1997; Newcomb, 2011). Therefore, it can be postulated that:

> ***"If earth's axial precession is a valid concept then it must correspond mathematically with recurrence of same season after fixed interval".***

Suppose the earth is at position "X" in the orbit at winter solstice; North Pole ("A") is oriented away from the sun and South Pole ("B") is directed towards the sun (Fig-2.9a). When the earth reaches to the point of summer solstice "Y" after revolution of 180° in the orbit the North Pole will be facing the sun whereas the South Pole will be oriented away from the sun. After an interval of 365.24219 days (tropical year) the North Pole should have same orientation relative to the sun to experience the same season. However, axial precession of the earth causes the North Pole to move clockwise in precession circle as described above. One complete precession cycle (360°) is assumed to be concluded in almost 25800 years (The Columbia E Enc, 2012). The North Pole will go to the position "A1" from "A" after precession of 180° in about 12900 years and will be sloping towards the sun at the position of winter solstice (Fig-2.9b). Orientation of North Pole towards the sun means it must be summer solstice. Consequently, winter solstice should completely change into summer solstice after axial precession of 180°. Thus the same season should not recur after fixed interval due to axial precession. Therefore, axial precession does not correspond to recurrence of the same season after fixed interval. Notion of axial precession, if valid, must upset the recurrence of same season after fixed interval thereby conflicting with the above hypothesis. However, recurrence of same season after fixed interval is an established fact (Angelo, 2014; Meeus and Danby, 1997; Newcomb, 2011) thereby rendering the concept of axial precession elusive.

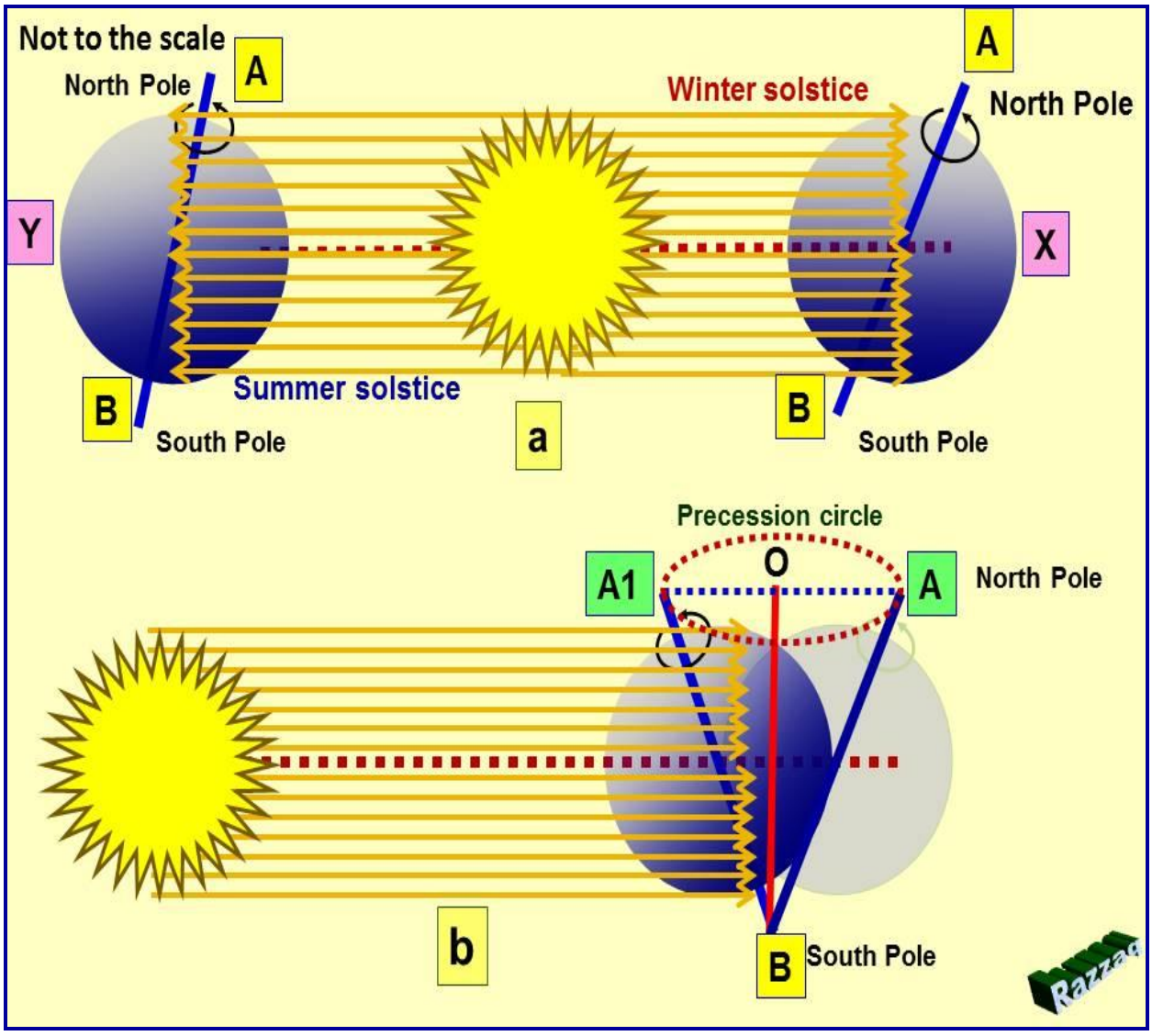

Fig – 2.9: Orientation of North Pole relative to the sun and precession. **A:** Orientation of North Pole during winter (**X**) and summer solstice (**Y**). **AB:** Axis of the earth. **b:** Orientation of North Pole due to precession. **A:** Orientation of North Pole with zero precession at winter solstice. **A1:** Orientation of North Pole at winter solstice with 180° precession.

Revolution of the earth (180°) in the orbit in 182.6211 days (365.2422 ÷ 2) takes the earth from winter solstice to summer solstice. An equivalent seasonal change should also be induced by precession of 180°. The seasonal change induced by precession is calculated below:

i) Precession of 180° is equivalent to 182.6211 days seasonal change

ii) Precession of 90° is equivalent to 91.31055 days

iii) Precession of 0.0139688667° is equivalent to

{(91.31055 ÷ 90) x 0.0139688667

= 0.01417227668 days or 1224.4847 seconds

Therefore, axial precession of 0.0139688667° (IERS, 2014) after one tropical year must delay recurrence of winter/summer solstice by 1224.4847 seconds almost equal to difference in lengths of sidereal and tropical years.

Imagine the earth was at winter solstice in the year 1810. In the year 2010 (after an interval of 200 years) the expected delay in occurrence of winter solstice is calculated below:

iv) Expected delay in winter solstice with an interval of 200 years

Interval from 1810 to 2010 = 200 years

Axial precession/year = 0.0139688667°

Delay in recurrence of winter solstice = 1224.4847 s/year

Precession in 200 year = 0.0139688667° x 200 = 2.79377334°

Delay in the recurrence of winter solstice

= {(1224.4847 ÷ 0.0139688667) x 2.79377334°}

= 244896.94 seconds or 68.026928 hours or 34.013464 hours/century

Axis of the earth is expected to precess by 2.79377334° during 200 years delaying the recurrence of winter solstice by 68.026928 hours. Thus recurrence of solstices must be delayed by 34.013464 hours per century. Nonetheless, no delay in occurrence of winter solstice or summer solstice has been reported during the last two centuries. Recurrence of successive winter solstices has been reported after fixed interval (Vogel & Dux, 2010) of 365.24219 days or 31556925.25 seconds. Almost same length of tropical year was reported in 1797 (Vince, 1797), 1838 (Kerigan, 1838), 1997 (Meeus & Danby, 1997) and 2012 (Ridpath, 2012). Consequently, established facts and observed realities do not conform to the mathematical implications of axial precession. So, the concept of axial precession seems vague without scientific legitimacy.

2.7 Axial precession and drifting of Polaris

One consequence of precession is stated that the North Star Polaris is drifting. Polaris is "North Star" only by coincidence today. Vega will be our North Star for a time in the distant future (Lang, 2013). Polaris and Vega alternate as North Star every 13000 years (Walker & Wood, 2010).

Suppose the earth is at winter solstice and its axis “AB” tilted 23.45° away from the sun is pointing to the North Star (Polaris) indicated by arrow “X” (Fig-2.10). As the axial tilt

does not change (Owen et al., 2010) so after precession of 180° in about 13000 years 23.45° tilted axis of the earth at position “A1B” will be leaning towards the sun, indicated by arrow “Y”. Now it should be pointing to Vega indicated by arrow “Y” as a consequence of the axial precession. The angle “ABA1” is 46.90° (23.45 + 23.45). Therefore, it becomes obvious that the angle between Vega and Polaris relative to the earth should be 46.90°. Nonetheless, as seen from the earth, the angle between Polaris and Vega is not 46.90° but is less than 1°. Consequently, it becomes obvious that the idea of axial precession is imaginary without any mathematical and logical validation.

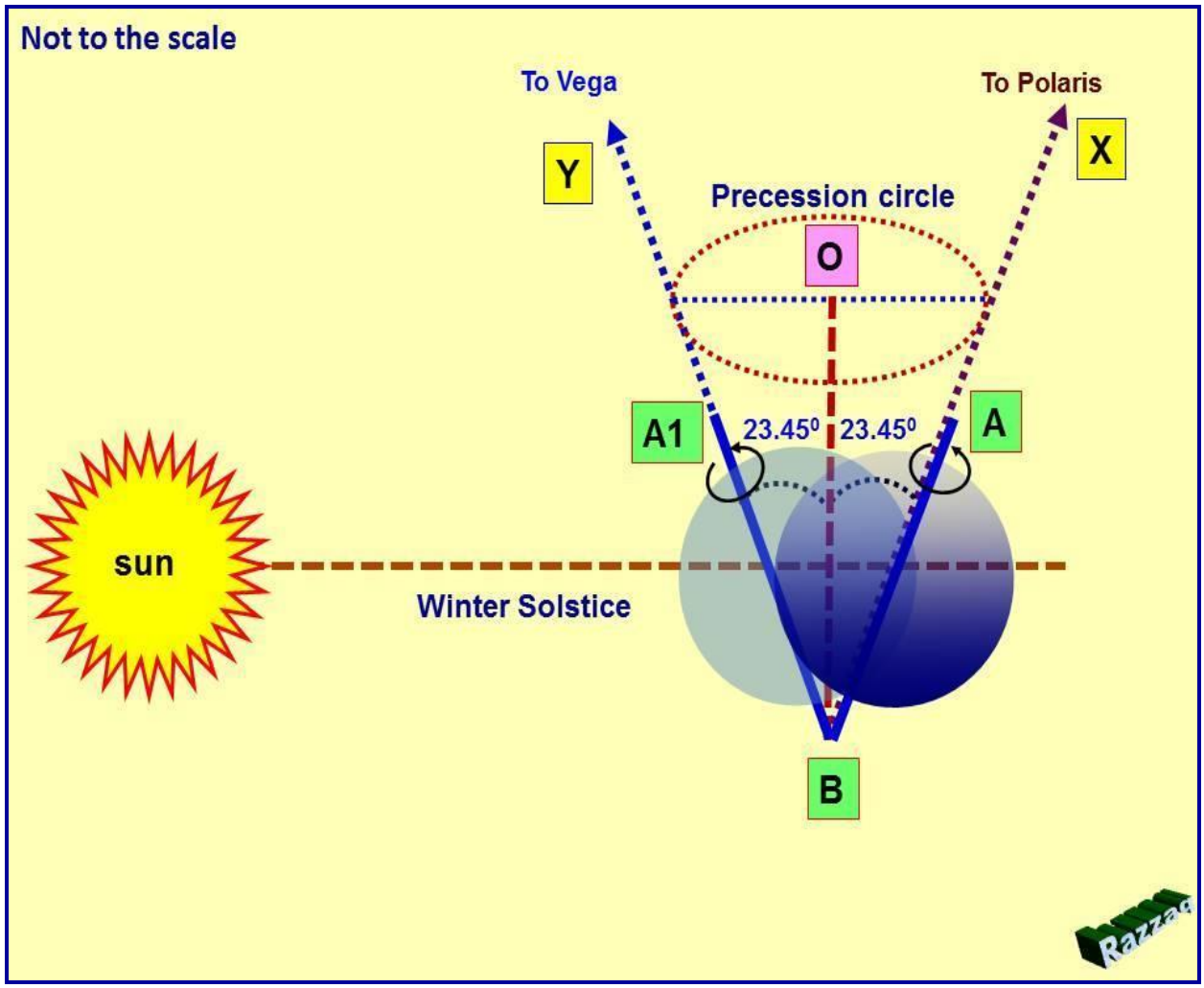

Fig – 2.10: Precession and angle between Polaris and Vega. **AB:** Tilted axis of the earth pointing to the Polaris with zero precession. **A1B:** Tilted axis pointing to Vega with 180° axial precession. **X:** Arrow pointing to Polaris. **Y:** Arrow pointing to Vega. **O:** Center of the precession circle.

2.8 Conclusion

Axial precession responsible for rising of the sun in new constellation each year has no legitimate and scientific validity. Sidereal year that has to be true revolution period, if axial precession is assumed true, cannot be rationalized mathematically. Axial precession does not correspond to same length of sidereal year at both poles, recurrence of same season after fixed interval and angle between Polaris and Vega. It cannot justify the difference between sidereal and tropical periods of revolution. Precisely determined values for tropical and sidereal periods of revolution by voluminous efforts of distinguished scientists need appropriate implications. Present concept of axial precession of the earth is surely a misconception and needs to be rectified. A certain link is definitely missing in understanding the solar system that is further confused with the assumption of axial precession. Real phenomenon causing the sun to rise in new constellation each year and mathematical evidence for 1224.51 seconds difference between the lengths of sidereal and tropical years for which concept of axial precession was coined will be explicated in the last chapter.

CHAPTER 3

3 TILTED AXIS OF THE EARTH, POLE STAR AND MERIDIANS

Postulates of heliocentric model subjected to logical and scientific criticism in this chapter for assessing their validity are enlisted below:

1- Axis of the earth is tilted 23.45° relative to the ecliptic. Revolution of the earth around the sun with tilted axis causes generation of different seasons.
2- Tilted axis of the earth always keeps pointing to the pole star throughout the orbital revolution.
3- Celestial and terrestrial axes, equatorial planes and parallels coincide.
4- Uniform time is observed on all points of a meridian (longitude) throughout the orbital revolution of the earth.

The sun is positioned in the center of the solar system according to the heliocentric model. The earth while rotating about its axis orbits around the sun. Axis of the earth is tilted 23.45° (Briggs and Taylor, 1986; Plait, 2002; Rohli and Vega, 2007) with respect to the ecliptic as represented in Fig-3.1A and always keeps pointing towards the pole star throughout the orbital motion (Franco, 1999; Gates, 2003; Kolecki, 2003; Plait, 2002; Wynn-Williams, 2005). Orbital revolution of the earth with tilted axis causes generation of various seasons (Moore, 2002; Plait, 2002; Rohli and Vega, 2007; Wynn-Williams, 2005). Orientation of the poles will determine whether it is summer or winter. When the North Pole is oriented towards the sun it will be summer and when the South Pole is directed towards the sun it will be winter (Fig3.1B). On summer solstice the sun is farthest north, on vernal equinox it will shine over the equator, on winter solstice the sun will be farthest south and shines again over the equator on autumnal equinox. However, there are some other consequences of earth's tilted axis which have to be analysed critically to assess the legitimacy of the tilted axis. In the following pages various implications of tilted axis, keeping in view the above mentioned postulates, are described logically and mathematically.

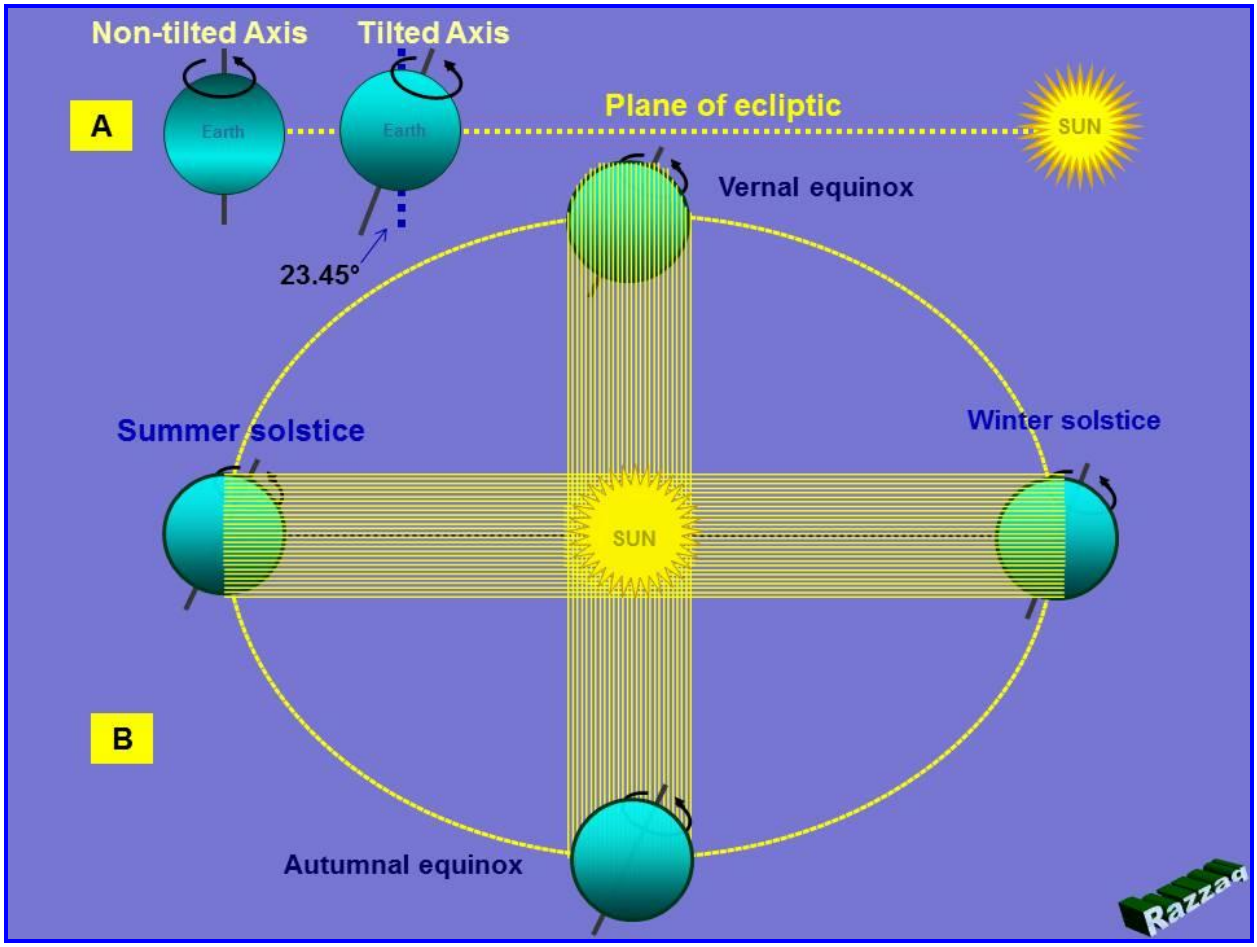

Fig – 3.1: Earth's tilted axis and generation of seasons. **A:** Earth's tilted and non-tilted axis relative to the ecliptic. **B:** Revolution of the earth in orbit with tilted axis and generation of four seasons.

3.1 Earth's tilted axis and the pole star

It is postulated in heliocentric model that earth's axis is tilted 23.45° relative to the ecliptic and always keeps pointing to the pole star throughout orbital revolution of the earth. This postulate is justified by assuming that as the pole star is far away and tilted axis remains parallel to itself at all positions, so it will practically keep pointing to the pole star throughout its motion in the orbit as presented in Fig- 3.2. The earth, from winter solstice, will go to vernal equinox, summer solstice and autumnal equinox in the orbit but tilted axis remains parallel to its initial position at winter solstice thereby always directing to the pole star.

Question arises what is the position of pole star with respect to the sun and earth's orbit. There might be two possibilities; i) pole star is positioned right above the sun i.e. perpendicularly above the ecliptic or ii) pole star is not right above the ecliptic but

situated somewhere in celestial sphere corresponding to tilting of the earth's axis. In other words celestial sphere is also tilted equivalent to the tilting of the earth. Both these possibilities are discussed here to assess the validity of tilted axis.

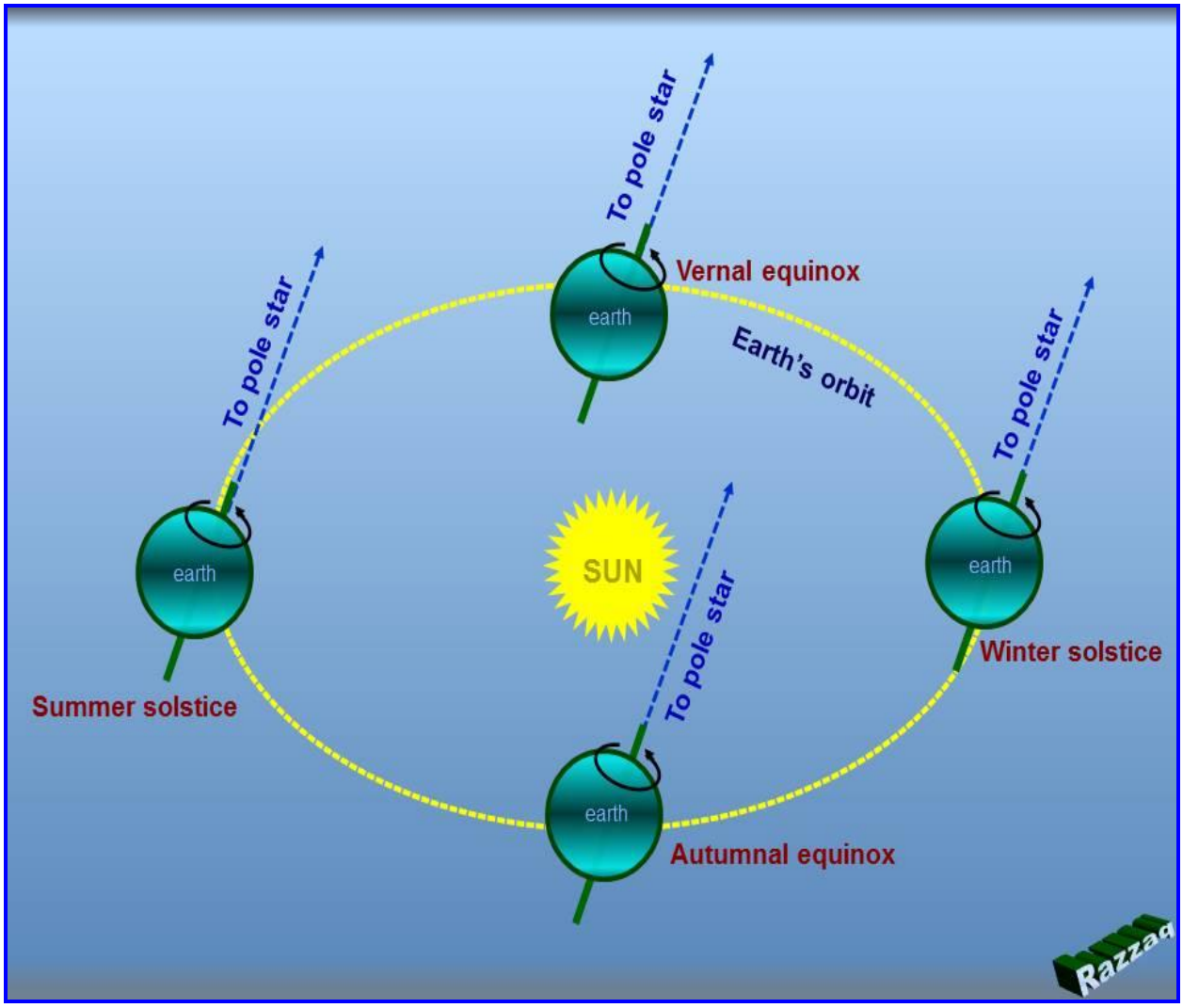

Fig – 3.2: Positions of the earth in orbit and lines parallel to the axis pointing to pole star

3.1.1 Pole star right above the sun

Suppose initially that the pole star is right above the sun (i.e. perpendicularly above the center of the ecliptic) that is positioned in the center of the celestial sphere. Let us analyze this concept for its mathematical confirmation. The earth moves from summer to winter solstice. Tilted axis of the earth at these two positions in the orbit points to the pole star. Then it can be hypothesized that:

> *"If the earth keeps its tilted axis pointing towards the pole star at summer solstice and also at winter solstice then principles of geometry should substantiate this concept".*

Suppose the earth is at position “A” in the orbit at summer solstice, the sun is at the center “o” of the orbit and arrow “s” indicates the location of the pole star right above the sun (Fig-3.3A). North Pole of the earth is oriented towards the sun.

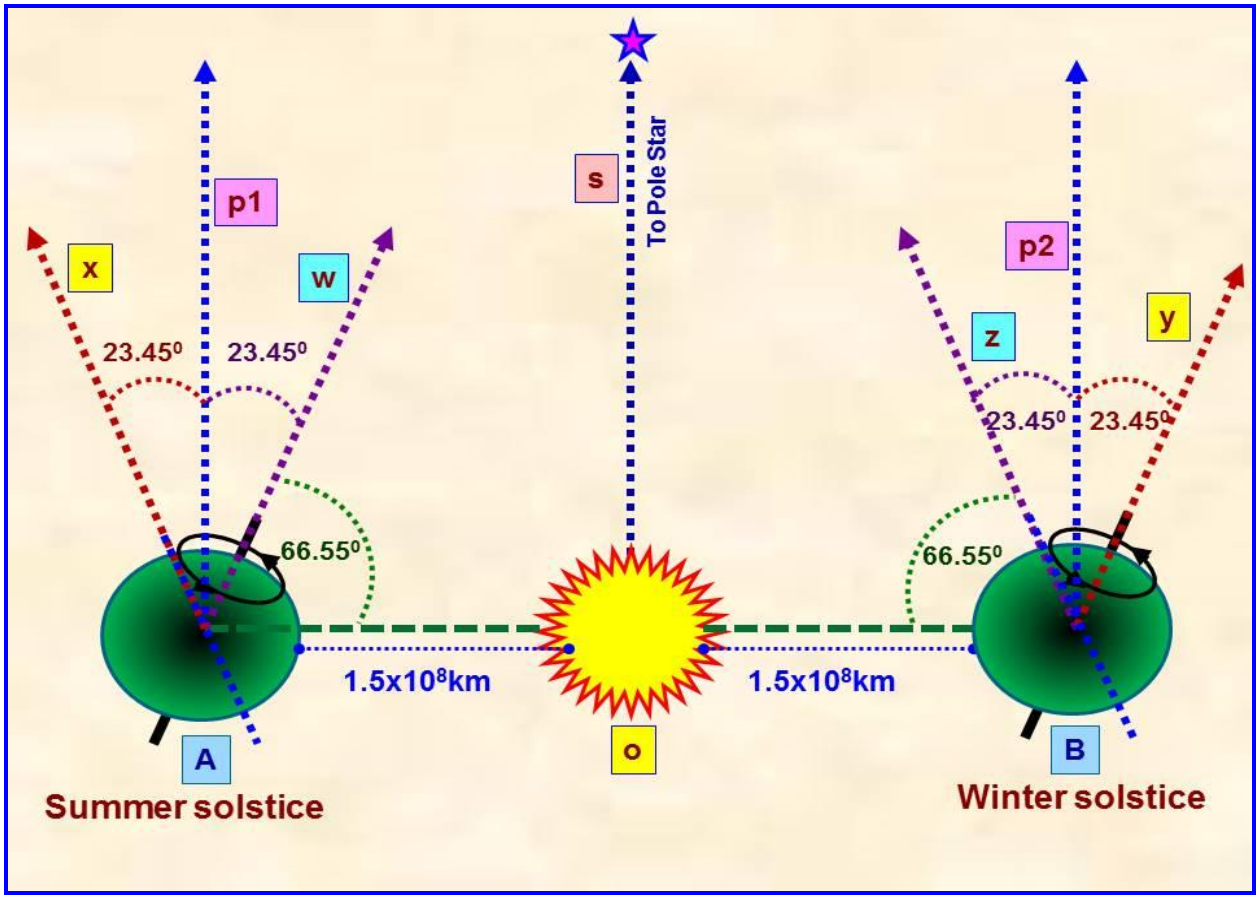

Fig – 3.3: Earth’s tilted axis and pole star. **A:** The earth at summer solstice, **w:** Arrow indicating the direction of axis pointing to the pole star, **p1. P2:** Verticals to the ecliptic, **s:** Arrow pointing to the pole star from the sun, **x:** Arrow making angle 23.45° on left side of vertical. **B:** The earth at winter solstice, **y:** Arrow indicating the direction of axis, **z:** Arrow pointing to the pole star parallel to arrow **“x”**.

As axis of the earth is tilted 23.45° and keeps pointing towards the pole star (Macdougall, 2004) so it will be directed towards the pole star at this position. This is indicated by an arrow “w”. Consider an arrow “x” making angle 23.45° with vertical to the ecliptic “p1” but on opposite side of the axis. The arrow “x” is not pointing towards the pole star. Orbital revolution of the earth with tilted axis is responsible for different seasons (Rohli and Vega, 2007). The earth orbiting around the sun will go to position “B” at the point of winter solstice after about six months. Now the North Pole of the earth will be oriented away from the sun at winter solstice. The axis of the earth at this position will be making angle of 23.45° with vertical to the ecliptic “p2” but on opposite side of the sun. So the axis will be pointing towards a distant point in the skies indicated

by the arrow “y”. Nonetheless, it will be parallel to arrow “w”, the direction of the axis at summer solstice. Principles of trigonometry reveal that there is no possibility the arrow “y” can point to the pole star irrespective of the distance of the pole star from the earth. It will be directed towards a distant point in the celestial sphere far-flung from the pole star. The axis can be directed towards the pole star only if it is tilted towards the sun at this position as is indicate by arrow “z”. It is believed theoretically that as the stars are far away, therefore the earth’s axis will remain parallel to itself pointing practically to the pole star (Gates, 2003; Kolecki, 2003; Rohli and Vega, 2007) but the principles of geometry do not validate this assumption. Therefore, it becomes evident that tilted axis of the earth cannot keep pointing towards the pole star even though it remains parallel to itself at all positions in the orbit if the pole star is located perpendicularly above the ecliptic. Hence, the aforesaid assumption is not rational and scientific.

Another mathematical implication of tilted axis pointing to pole star located right above the sun will also reveal that this concept is not scientifically valid. Principles of trigonometry do not support this notion. The earth is about 1.50×10^8 km from the sun (Bowditch, 2004; Zeilik, 2002). If axis of the earth is tilted 23.45° relative to the ecliptic then the angle between the ecliptic and axis of the earth will be 66.55° (Fig-3.3). Earth-sun-pole star will make a right-angle triangle. Using the principles of trigonometry, distance of the pole star from the earth can be calculated as follows:

i) Distance of pole star from the earth
Cos θ = base / hypotenuse, θ (sun-earth-pole star angle) = 66.55°
Hypotenuse (distance of pole star from the earth)
Base (distance of the sun from the earth) = 1.50×10^8 km
Hypotenuse = (base / Cos θ) = (1.50×10^8 ÷ cos66.55°) = 3.7693×10^8 km

Consequently, distance of the pole star from the earth should be 3.7693×10^8 km. This is against the established fact that the stars are far away from the earth and their distance can be measured only in light years. The star nearest to the earth is at a distance of more than four light years (Baker and Fredrick, 1968) whereas pole star is about 63 light years away from the earth (Poynting, 2012). Therefore, it becomes obvious that either the axis of the earth is not tilted or the pole star is not situated right above the center of the ecliptic. Earth’s axis can only point towards the pole star if the angle of tilt is very small (almost zero). Nevertheless, this will invalidate the concept of 23.45° tilting of

earth's axis and in turn generation of different seasons due to orbital revolution of the earth around the sun with tilted axis.

Another postulate of heliocentric model is that celestial sphere is just like earth. Terrestrial and celestial axes, equatorial planes and parallels coincide (Roddy, 2006). Celestial poles are extent of earth's poles. The two equatorial planes are virtually same and it is fixed while earth rotates (Farley, 2014) and orbits the sun with tilted axis. If the sun is in the center of celestial sphere, pole star is located right above the sun and the earth is tilted 23.45° then terrestrial coordinates cannot coincide with celestial coordinates as is presented in Fig-3.4.

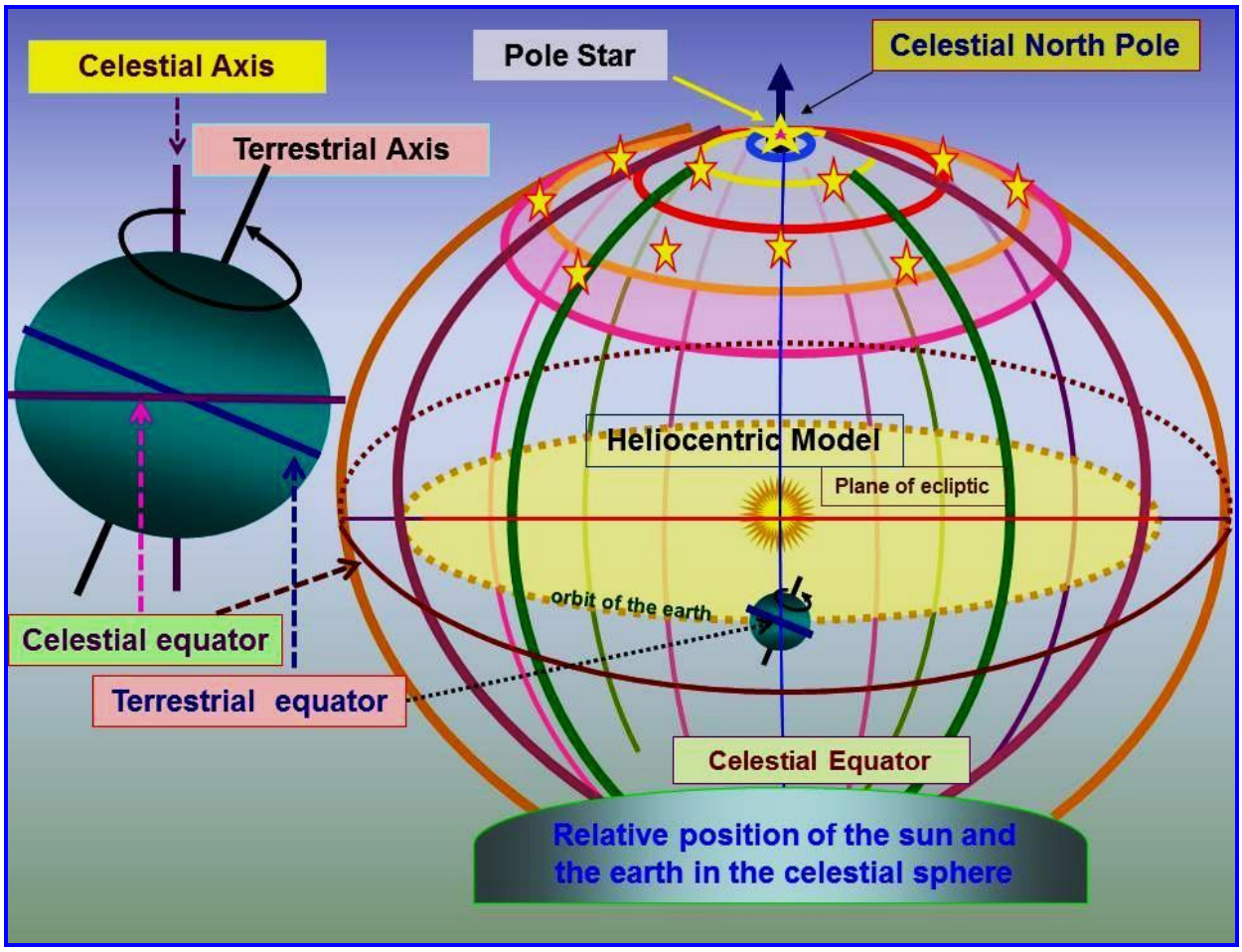

Fig -3.4: Pole star right above the sun, tilted earth, terrestrial and celestial coordinates

Celestial axis and equatorial plane will not coincide with the terrestrial axis and equatorial plane. Therefore, either axis of the earth is not tilted or terrestrial and celestial coordinates do not coincide. However there are strong evidences that terrestrial and celestial coordinates coincide (Farley, 2014; Shipman et al., 2015). The earth has been

assumed tilted just to rationalize generation of four seasons with revolution of the earth around the sun. However, supposition of earth's tilting does not seem rational, logical and scientifically valid.

The earth cannot keep its axis continuously pointing towards the pole star throughout its orbital motion if the axis is tilted, the sun is present in the center of the celestial sphere and the pole star is right above the sun. There is no possibility for the earth's axis to point towards pole star situated right above the sun. Hence this possibility is ruled out.

3.1.2 Tilted celestial sphere

Alternately, it can be assumed that the pole star is not located perpendicularly above the ecliptic instead it is positioned somewhere in the celestial sphere corresponding to 23.45° tilting of the earth's axis or the celestial sphere is also tilted (McKirhan, 2015; Shaffer, 1999; Shipman et al., 2015) relative to the ecliptic equivalent to tilting of the earth as illustrated in Fig-3.5A. It may be assumed that the size of the earth's orbit being very small compared with the vastness of the celestial sphere will not affect the direction of terrestrial axis to the pole star. The celestial coordinates will also coincide with the terrestrial coordinates satisfying the postulate (Barbieri, 2006).

It is an established fact that an observer at specific position on the earth always views the pole star at the same direction. Pole star does not appear to change its direction from the earth (Williams, 2003; Narlikar, 1996). The pole star appears at the same position throughout the year without any change in position of the observer with respect to his surroundings on the earth. Consequently, tilting of celestial sphere should correspond to visibility of pole star at the same position from a fixed point on the earth. Let us analyse if this concept is logically true and corresponds to the observed realities. If the above assumption i.e. "celestial sphere is tilted corresponding to tilted axis of the earth" is true then it can be hypothesized that:

> *"An observer on the earth should be able to view the pole star at the same position/angle throughout the orbital revolution of the earth without changing his position relative to the surrounding objects".*

A perpendicular "p" is drawn from the pole star on the extended orbital plane of the ecliptic. It falls outside the orbit of the earth (Fig-3.5A & B). This implies that the pole star is situated on one side of the orbit if celestial sphere is tilted corresponding to tilting of the earth.

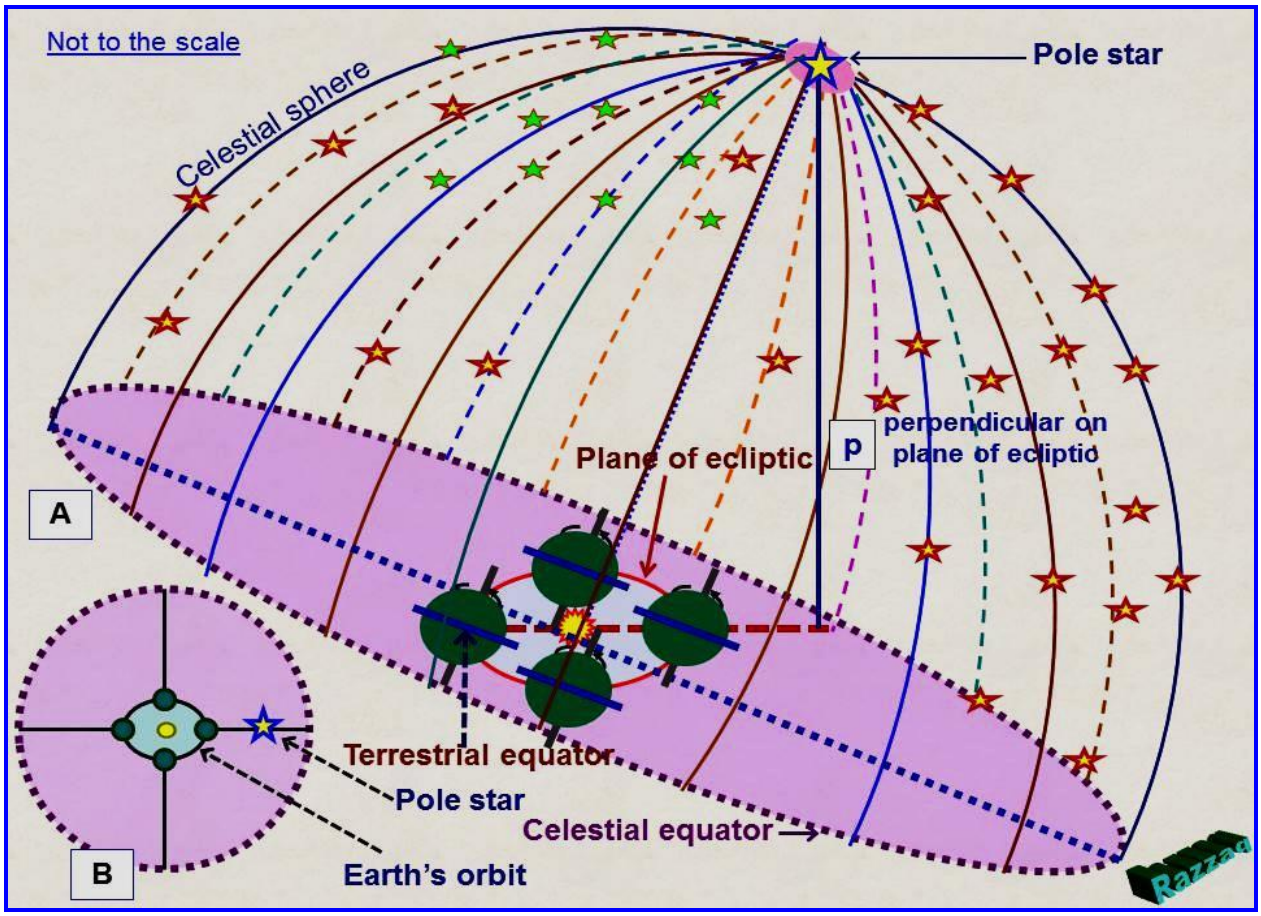

Fig – 3.5: Tilting of the celestial sphere equivalent to tilted earth. **A:** Position of the pole star, ecliptic and tilted earth in tilted celestial sphere. **p:** Perpendicular drawn from the pole star to the extended plane of ecliptic. **B:** Imaginary plane view of celestial sphere with pole star and earth's orbit.

Let us suppose that an observer standing on the earth at a position "O" at night during winter views the pole star "s" over a tall building "P" in front of him indicated by an arrow "w" (Fig-3.6a). After about six months the earth goes to other side of the sun at the position of summer solstice. Position of the observer "O" relative to the building "P" during day and night time is represented in Fig-3.6b. Position of the pole star relative to the observer, indicated by the arrow "x", will be almost same during day time. However, the stars are not visible during day time. At night time the observer while facing the building "P" will look at the point in the sky arrow "y" points to. But he will not find the pole star at that point. The pole star will be at his back side. He will be able to view the pole star if he turns around and the reference building is on his back side. Pole star will be visible to him in the direction of arrow "z". Hence, to view the pole star the observer needs to turn around about 180° if the celestial sphere is supposed tilted otherwise he may not be able to view the pole star. Nonetheless, the pole star can be viewed at the

same position/angle throughout the year without any turning or change in position relative to the surroundings. The pole star does not change its direction from any position of the earth (Plait, 2002; Williams, 2003). Pole star is always visible at the same position throughout the year without any change in position of the observer relative to his surroundings.

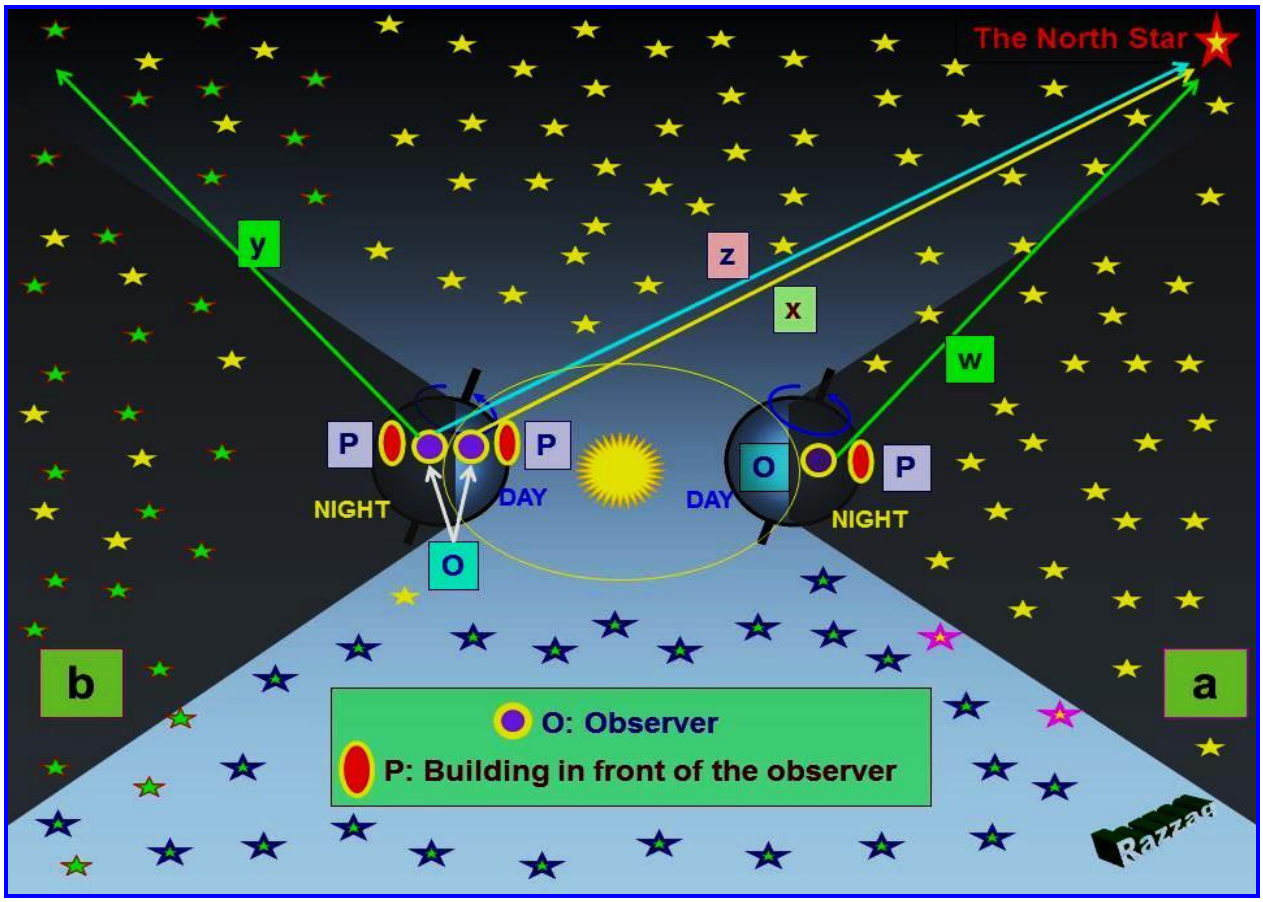

Fig – 3.6: View of pole star by an observer relative to a building in tilted celestial sphere. **a:** View of pole star over a tall building in winter, **O:** Observer on the earth, **P:** A tall building in front of the observer, **W:** Arrow pointing to the pole star. **b:** View of pole star and observer relative to the reference building during day and night in summer, **x:** Arrow pointing to the pole star during day time, **y:** Arrow pointing to the point in the sky the observer will look for pole star over the tall building at night, **z:** Arrow pointing to actual position of pole star at night.

Consequently, it can be concluded that idea of tilted celestial sphere is not rational and justifiable at all. If celestial sphere is not tilted then there will be no probability for the celestial equator to coincide with the terrestrial equator against the well-established concept (Hoffman-Wellenhof and Moritz, 2005; Norton and Cooper, 2004). Ultimately it can be inferred that neither tilting of the celestial sphere nor positioning of the pole star right above the sun (i.e. perpendicularly above the ecliptic) conforms to the established concepts and observations. Therefore, the postulate that 23.45° tilted axis of the earth

(Briggs and Taylor, 1986) keeps pointing continuously towards the pole star (Gates, 2003; Macdougall, 2004) throughout the orbital revolution has no legitimate validity. Either the earth is not tilted or the axis does not point permanently to the pole star.

How can the earth keep its 23.45° tilted axis pointing towards the pole star while orbiting around the sun? There may be three more possibilities the earth can keep its tilted axis pointing continuously towards the pole stars at all positions in the orbit:

1- Perpetual revolving of earth's axis, as assumed by Copernicus, can keep it pointing continuously to the pole star. Nonetheless, this assumption would upset the system of generation of four seasons. Therefore, modern astronomers set aside this axiom of Copernicus (Steiner, 1921) and assumed that as the pole star is far away, therefore the earth's axis will remain parallel to itself pointing practically to the pole star (Plait, 2002). Mathematical validity of this assumption is already discussed and nullified.

2- Second possibility the earth can keep its axis pointing towards the pole star is that the pole star should travel corresponding to motion of tilted earth in the orbit. Consequently, the axis of the earth will always be directed towards the pole star. However, the stars do not move according to the postulate of heliocentric theory and the pole star never appears to move in between the stationary stars. Therefore, it is not possible for the earth to keep its axis pointing towards the pole star while travelling in the orbit. Hence, this possibility is also ruled out.

3- The earth is located in the center of the celestial sphere underneath the pole star, is the third possibility the earth can keep its axis pointing towards the pole star. Its axis is not tilted and does not revolve around the sun. Earth's axis, equatorial plane and parallels will coincide with those of the celestial sphere in conformity to established reality (Hoffman-Wellenhof and Moritz, 2005; Norton et al., 2004). This way the axis of the earth will always keep pointing towards the pole star in agreement with the postulate (Macdougall, 2004). However, this assumption is in contradiction with the postulate of heliocentric theory that asserts non-centric position of the earth orbiting around the sun with tilted axis. Acceptance of this possibility will deny heliocentric model.

How the earth can keep its tilted axis always pointing to the pole star without contradicting with other observed realities and established facts? This is the riddle for which heliocentric model has no mathematical and logical solution

3.2 Tilted axis of the earth and time meridians

Meridians or longitudes are imaginary lines on the surface of the earth extending from North Pole to South Pole (Kolecki, 2003; Stern, 2004) for determination of time. The mean solar time determined on Greenwich or Prime Meridian, the meridian that runs through Greenwich UK, is called Universal Time or Greenwich Mean Time (Famighetti, 1998). All points on the same longitude experience noon (or any other hour) at the same time and are said to be on the same meridian (Feeman, 2002; Stern, 2004; Wynn-Williams, 2005). If a longitude/meridian directly faces the sun then it will be noon everywhere on it at that moment. Consequently, alignment of the reference meridian to the sun rays should remain same throughout the orbital motion for same time. Revolution of the earth around the sun generates different seasons (Moore, 2002). Axis of the earth is assumed tilted 23.45° (Plait, 2002; Rohli and Vega, 2007) to explain generation of different seasons. Hence it can be hypothesized that:

> *"Revolution of the earth in orbit with tilted axis should not affect occurrence of uniform time throughout the length of a meridian at all positions of the earth in the orbit or alignment of the meridian to sun-rays will not change with change in position of the earth in orbit".*

Let us suppose it is noontime in Greenwich UK during summer solstice. Therefore, all locations on Greenwich meridian will experience noontime. As the sun rays falling on the earth are parallel (Marion, 2012; Nathan, 2014; Sang and Jones, 2012) so the central meridian at noontime will be parallel to the sun rays. Alignment of Prime Meridian (Greenwich Meridian) to the radiation from the sun at noontime (12.00 GMT) during summer solstice is depicted in Fig-3.7 (A & B). Obviously, the alignment of Greenwich meridian is parallel to radiation from the sun. Greenwich meridian will also be aligned parallel to the sun rays at noontime during winter solstice (Fig-3.7A & B). Hence, it can be inferred that alignment of reference meridian remains parallel to the sun rays at summer and winter solstice to experience noontime throughout its length. Nonetheless, the earth while revolving in the orbit moves from summer solstice to autumnal equinox, winter solstice and then to vernal equinox (Fig-3.8A). Suppose the earth is at the point of vernal equinox in the orbit and it is noontime at Greenwich meridian. Relative position of tilted axis of the earth "x" and alignment of Greenwich meridian "y" to sun rays during

vernal equinox is represented in Fig-3.8B. It is evident that alignment of Greenwich meridian “y” (red color) is not parallel to the sun rays due to tilting of the earth but makes an angle of 23.45°. Therefore, it should result in different times at different locations on Greenwich meridian. Only central point of this meridian will experience noontime. Upper half of the meridian should experience *post meridiem* time (afternoon) whereas the lower half should be at *ante meridiem* position (forenoon). The point “e” of this meridian will experience morning time whereas point “f” will have evening time.

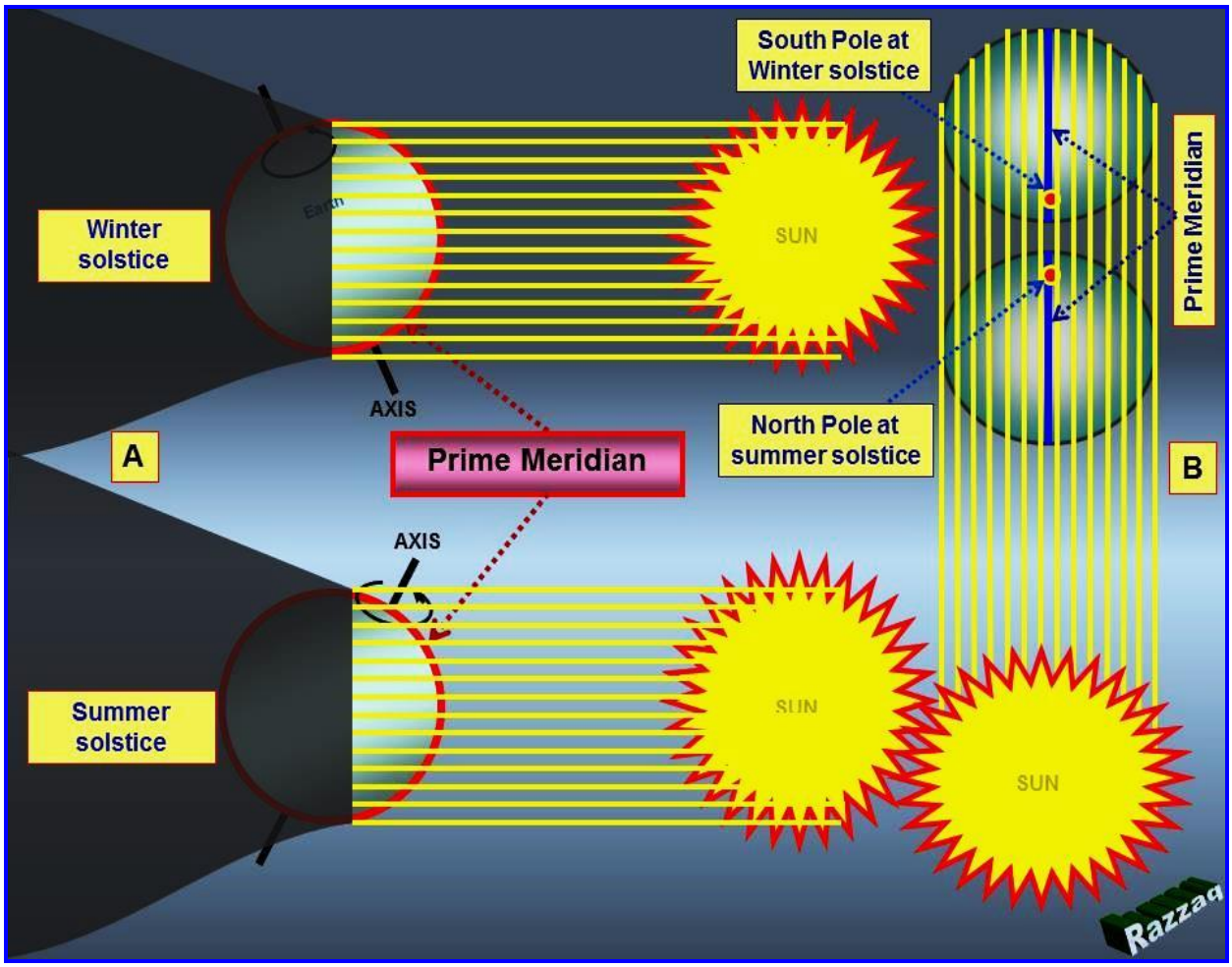

Fig – 3.7: Alignment of Greenwich Meridian to sun rays at winter solstice and summer solstice.
A: Side view, **B:** Plane view.

Thus all points of Greenwich meridian cannot experience same time if the earth is tilted. The line “z” (blue color) will be aligned parallel to the sun rays when the earth is at vernal equinox with tilted axis. All locations falling on the line “z” will experience noontime. Greenwich meridian can have noontime throughout its length if it is aligned parallel to sun rays. Nevertheless, it may be parallel to the radiation from the sun at

12.00 GMT during vernal equinox only if it takes the position of line “z”. This is only possible if the earth is not tilted. Similar situation will arise in autumnal equinox.

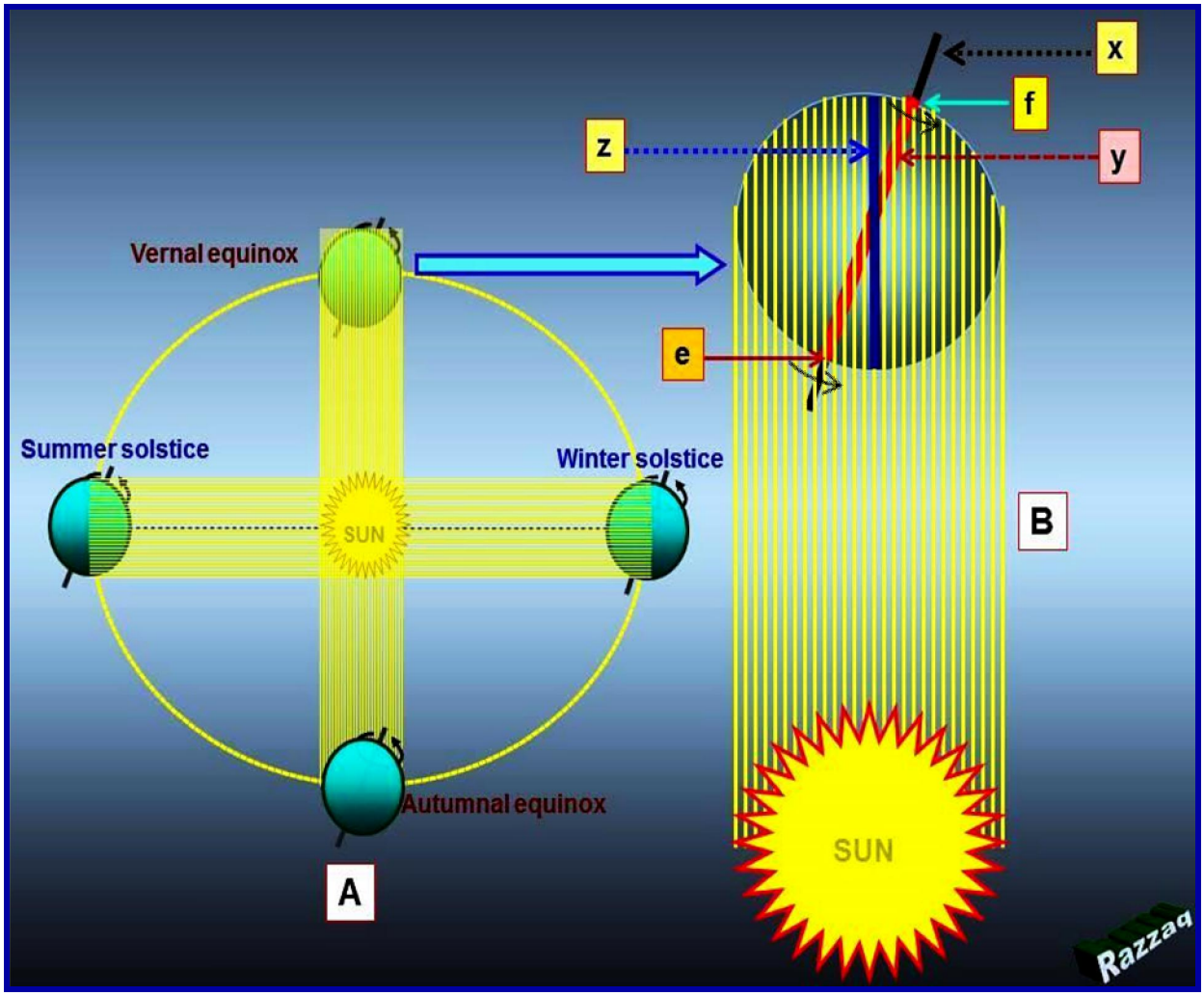

Fig – 3.8: Positions of the earth in orbit and alignment of Greenwich meridian to sun rays. **A:** Positions of the earth at summer solstice, autumnal equinox, winter solstice and vernal equinox. **B:** Detailed view of the earth at vernal equinox. **x:** Axis of the earth, **y:** Greenwich meridian, **z:** Line parallel to sun rays with noontime. **e:** Point on Greenwich meridian with morning time **f:** Point on Greenwich meridian with evening time.

Consequently it can be concluded that if all locations on Greenwich meridian experience noontime at 12:00 GMT at vernal equinox then it should be parallel to the radiation from the sun. Conversely, if Greenwich meridian is not parallel to the radiation due to tilting of the earth then all locations on this meridian cannot experience noontime at 12:00 GMT. Therefore, it is not illogical to conclude that if the earth is tilted then the central meridian will not be parallel to the radiation from the sun to experience noontime during all seasons. Thus the above hypothesis is not rational. Same time throughout the length of

the meridians cannot occur if the earth orbits the sun with tilted axis. Subsequently it may be concluded that either the meridians do not experience same time during all the seasons or the earth is not tilted. However, it is an established fact that all points on the same meridian experience same time of the day throughout the year (Feeman, 2002; Stern, 2004; Wynn-Williams, 2005). Consequently we have to believe that hypothesis of earth's tilting has no rationale. If the earth is proved non-tilted then generation of seasons cannot be justified and heliocentric theory shall stand null and void leading to its legitimate refutation.

3.3 Conclusion

Above mentioned logical and scientific evidences obviously manifest that there is no possibility for tilted axis of the earth to keep pointing to the pole star. Coincidence of celestial and terrestrial axes and equatorial planes do not correspond to the tilted axis. This concept also has no correlation with visibility of pole star at the same position from the earth throughout the year and uniform time on the meridians at all positions of the earth in orbit. Consequently, assumption of earth's tilting is not rational but scientifically invalid with mathematical limitations.

CHAPTER 4

4 EARTH'S AXIAL ROTATION, ORBITAL REVOLUTION AND THE STARS

Followng postulates of heliocentric model are discussed in this chapter:

1- The earth rotates about its axis and completes one rotation relative to the stars in sidereal day whereas it completes on rotation relative to the sun in one solar day.
2- The earth revolves around the sun that is located in the center of the celestial sphere. The earth completes one revolution relative to the sun in tropical year and completes one revolution relative to the stars in sidereal year.
3- The stars are stationary. East to west daily motion of the stars is caused by the rotation of the earth about its axis.

The earth is like a globe of radius (equatorial) 6378.388km (Briggs and Taylor, 1986). It spins around its own axis with a speed of about 1600 km/h (Halsey, 1979) and completes one rotation in 23 hours, 56 minutes and 4.09 seconds (Crystal, 1994). This motion is called rotation and the line around which it turns is called axis of rotation. The earth's axis of rotation runs through the North Pole, the center of the earth, and the South Pole. As the earth rotates a given part of it comes into the range of light from the sun (Branley, 2015) for a part of the time (daytime) and then rotates out of that range (night time). The earth is a planet orbiting around the sun (Whitlow, 2001) with a speed of 30 km/s along a roughly circular path called orbit with an average radius of 1.4947×10^8 km (Briggs and Taylor, 1986). This motion is known as orbital revolution. The earth completes one orbital revolution relative to the sun in approximately 365.2422 days (Crystal, 1994; ILSC, 1970). However, it completes one revolution relative to the stars in about 365.2564 days (Kelley & Milone, 2011).

If these postulates of heliocentric model are true and valid then non-centric mobile position of the earth rotating about its axis should match with the established facts and observed realities according to the most recent numerical values. This should also be substantiated mathematically and logically. Visibility and apparent motion of the stars assumed stationary should also correspond with the observations and established scientific principles to prove the competency of heliocentric model.

4.1 Earth's rotation, revolution and the reference star

The earth spins about its axis in anti-clockwise direction. The stars appear to rise in the east and set in the west due to the rotation of the earth (Ellyard and Tirion, 2008). The earth also moves counter-clockwise in orbit around the sun (Whitlow, 2001; Shubin, 2011). The earth completes its rotation relative to the fixed stars in sidereal day (Crystal, 1994). Sidereal day is considered true period of rotation. Because orbital displacement of the earth in orbit is insignificant with respect to the stars therefore the reference meridian on earth will be at the same position relative to the reference star after rotating exactly 360° in sidereal day (Snodgrass, 2012). A star found at one location in the sky will be found at the same position on another night at the same sidereal time at all positions of the earth in orbit as depicted in Fig-4.1. At position "1" of the earth in orbit the arrow "s1" is pointing to reference star "A" from the observer. At positions "2", "3", "4" and "5" of the earth arrows "s2", "s3", "s4" and "s5", respectively will be parallel to "s1" pointing to the same star "A".

Length of the sidereal day is same, no matter what star is used for reference (Gray, 2008). Let us consider the star "B" as a reference star and arrow "x1" is pointing to the star "B" from the observer on the earth at location "1" in the orbit (Fig-4.1).

When the earth moves to positions "2", "3", "4" and "5" in the orbit the arrows "x2", "X3", "x4" and "x5", respectively parallel to arrow "x1" will be pointing to the reference star "B". Every time the earth completes its rotation the observer will be facing the same star at the same position. Orbital displacement of the earth in orbit has no effect on position of the reference star in the sky. Therefore, it has been assumed that:

> *"As the distance of the stars is so great hence change in position of the earth in orbit makes no sensible difference in the relative positions of the stars in the sky (Dunkin, 2010; Gray, 2008)". Or*
>
> *"As the orbit of the earth is small and the stars are far away from the earth therefore at all positions earth-star lines will remain parallel pointing practically to the reference star after every rotation throughout the orbital motion of the earth (Kirkpatrick and Francis, 2009; Stachurski, 2009)".*

According to the above assumptions orbital displacement of the earth should have no effect on view of the reference star at the same position every time the earth completes

its rotation. These assumptions are analyzed logically and mathematically in the following pages.

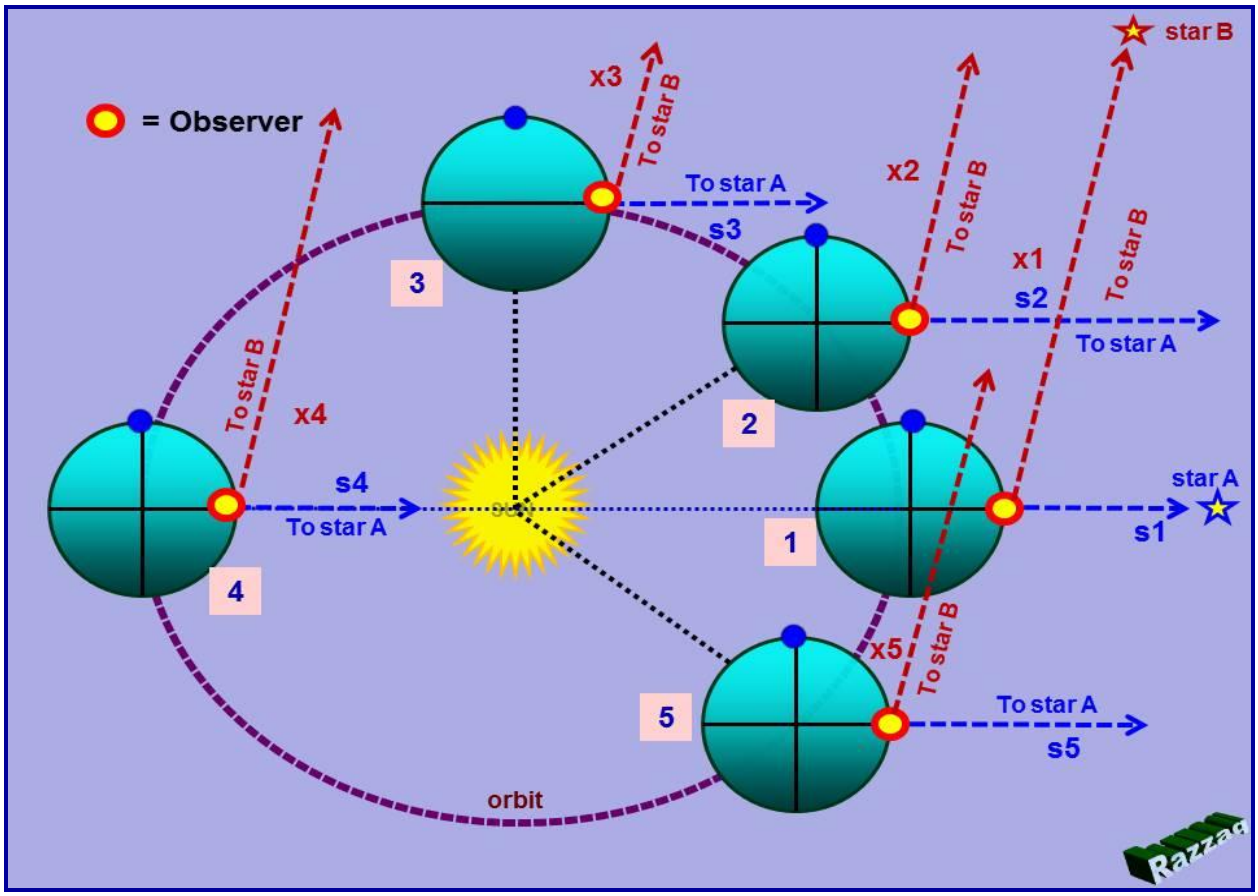

Fig – 4.1: Orbital revolution of the earth and observer-star parallel lines. **1, 2, 3, 4**, **5:** Positions of the earth in orbit. **A, B:** Reference stars, **s1:** Arrow pointing to the reference star "A". **X1:** Arrow pointing to the star B. **s2, s3, s4** and **s5:** Arrows parallel to s1. **x2, x3, x4**, **x5:** Arrows parallel to x1.

4.1.1 Observer-star parallel lines and the reference star

Above assumptions made to justify rotation period of the earth relative to the stars, despite orbital motion of the earth, reveal that if the observer to star lines are parallel then the observer will be able to view the same star at same position after every 360° rotation of the earth. Location of the earth in orbit will not affect the position of the reference star because the stars are far away and size of the orbit is small. At all locations of the earth in orbit the observer will be aligned to the same star each time the earth completes its rotation. Therefore it may be hypothesized that:

"*As the size of earth is even smaller than the orbit and the stars are far away from the earth so the observer-reference-star lines if remain parallel should make the reference star appear at the same position to the observer".*

Let us consider the earth at position “X” in the orbit, an observer at location “a” on the earth and arrow “s1” is pointing to a reference star “r1” as depicted in Fig-4.2. The position of the earth and the observer after five days with revolution period of 31556925.25 seconds and rotation period of 86164.09053083288 seconds (IERS, 2014) is calculated below:

i) Revolution of the earth in 5 days:

Revolution of the earth in tropical year (31556925.25 sec) = 360°
One day = 86400 sec, Five days = 432000 sec
Revolution of the earth in 5 days =
{(360 ÷ 31556925.25) x 432000} = 4.928236°

ii) Rotation of the earth in 5 days:

Rotation of the earth in sidereal day = 360°
(86164.09053083288 sec)
Rotation of the earth in 5 days =
{(360 ÷ 86164.09053083288) x 432000} =
1804.928236° or 5 complete rotations + 4.928236°

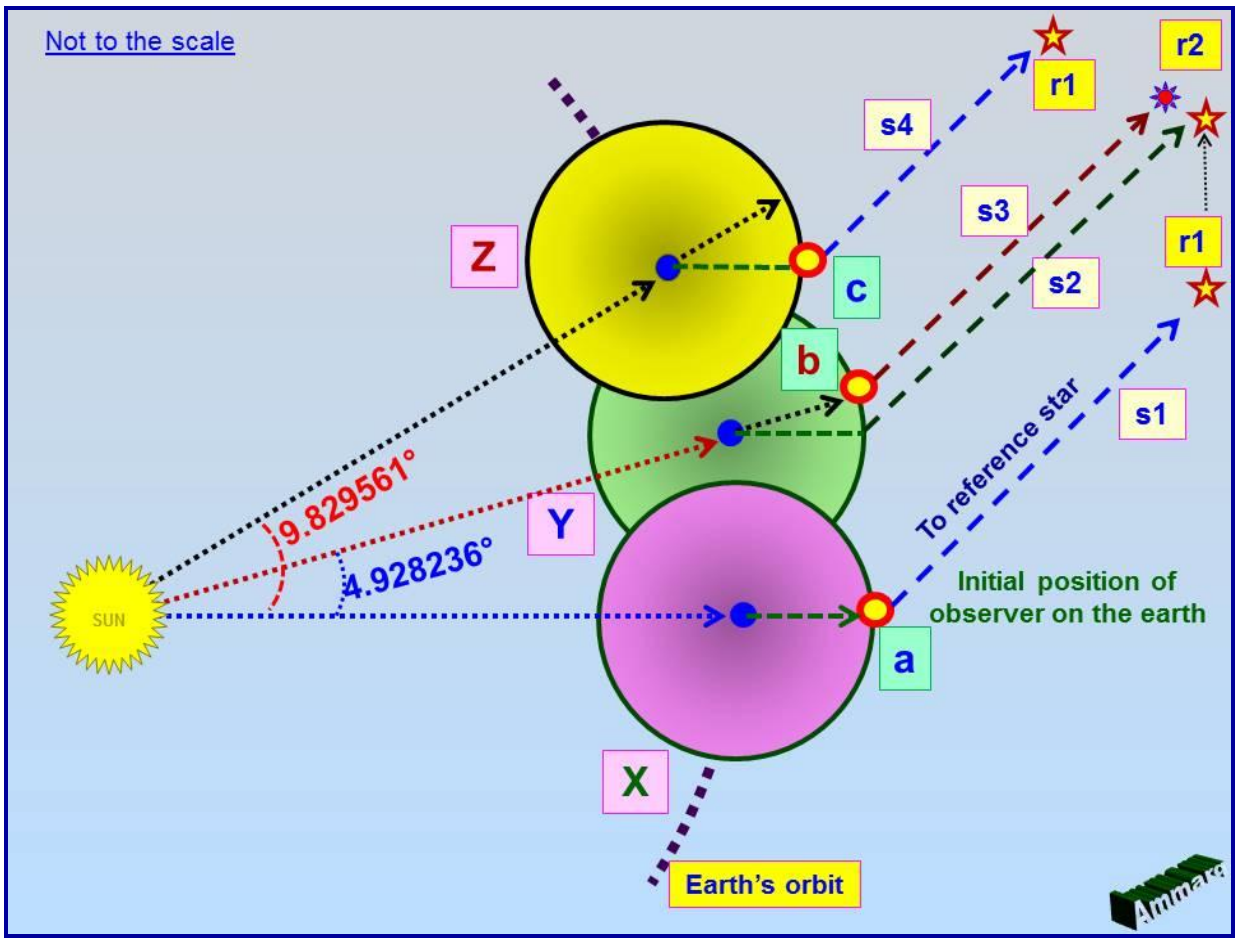

Fig – 4.2: Earth’s rotation, revolution and the reference star. **X:** Initial position of the earth in orbit. **a:** Initial position of observer on the earth. **s1:** Arrow pointing to the reference star **“r1”** from the observer. **Y:** Position of the earth in orbit after 5 days. **b:** Position of observer after 5 days. **Z:** Position of the earth in orbit after 10 complete rotations. **C:** Observer on earth after 10 rotations of the earth. **s2, s3, s4:** Arrows parallel to “**s1**”. **r2:** A star other than the reference star.

When the earth is displaced from position “X” to “Y” in the orbit after 5 days the reference star will be at the same position relative to the earth because orbital displacement of the earth makes no sensible difference in relative position of the stars (Dunkin, 2010; Gray, 2008). According to the assumption, as the earth-star lines remain parallel so the arrow “s2” must be parallel to arrow “s1” to make the star appear at the same position relative to the earth. Let us suppose that arrow “s3” is also parallel to arrow “s1” then observer should also be at the same position with respect to the reference star “r1”. However, after five complete rotations + 4.928236° axial rotation of the earth, the observer will be at position “b” on the earth and cannot view the same reference star “r1” at the same position. The observer will view some other star (“r2”) at the same angle. He will notice clockwise shift in the position of the reference star. It means arrow “s3”, although parallel to “arrow “s1” will not be pointing to the reference star. The arrow “s2” parallel to “s1” keeps the earth at same position relative to the reference star “r1” but the observer at position “b” after 5 days will not be able to view the same star “r1” at the same position even if arrow “s3” is parallel to “s1. This is amazing. Now consider the position of the earth in orbit after 10 complete rotations as calculated below:

iii) Time required for 10 rotations of the earth

Time required for 10 rotations =

86164.09053083288 x 10 = 861640.9053083288 sec

iv) Revolution of the earth after 10 completes rotations:

Revolution of earth in 861640.9053083288 sec

= {(360 ÷ 31556925.25) x 861640.9053083288} = 9.829561°

After 10 complete rotations of the earth the observer will be at position “c” while the earth will be at position “Z” after revolving 9.829561° in the orbit. Arrow “s4” parallel to “s1”, “s2” and “s3” will be pointing to the same star. The observer will view the reference star at the same position and the earth will also be at same position relative to the star. Consequently, at position “b” the observer cannot be at the same position relative to the reference star even though arrow “s3” is parallel to “s1” and “s2”. Hence the hypothesis that lines parallel to the observer-reference-star line should make the star appear at the same position to the observer is not valid, logical and acceptable. Lines parallel to observer-reference-star line cannot make the star to appear at the same position to the

observer. This is in contradiction with the assumption (Beet, 2015) to justify appearance of the same star at same position after every rotation from all positions of the earth in the orbit.

The above deduction is further explained with another example. Consider an observer at position “m” when the earth is at position “A” in the orbit (Fig-4.3). The arrow “u”, parallel to the axis of rotation, points to a reference star near the pole star from the observer. Arrow “v” indicates the direction of axis to the pole star (North Star).

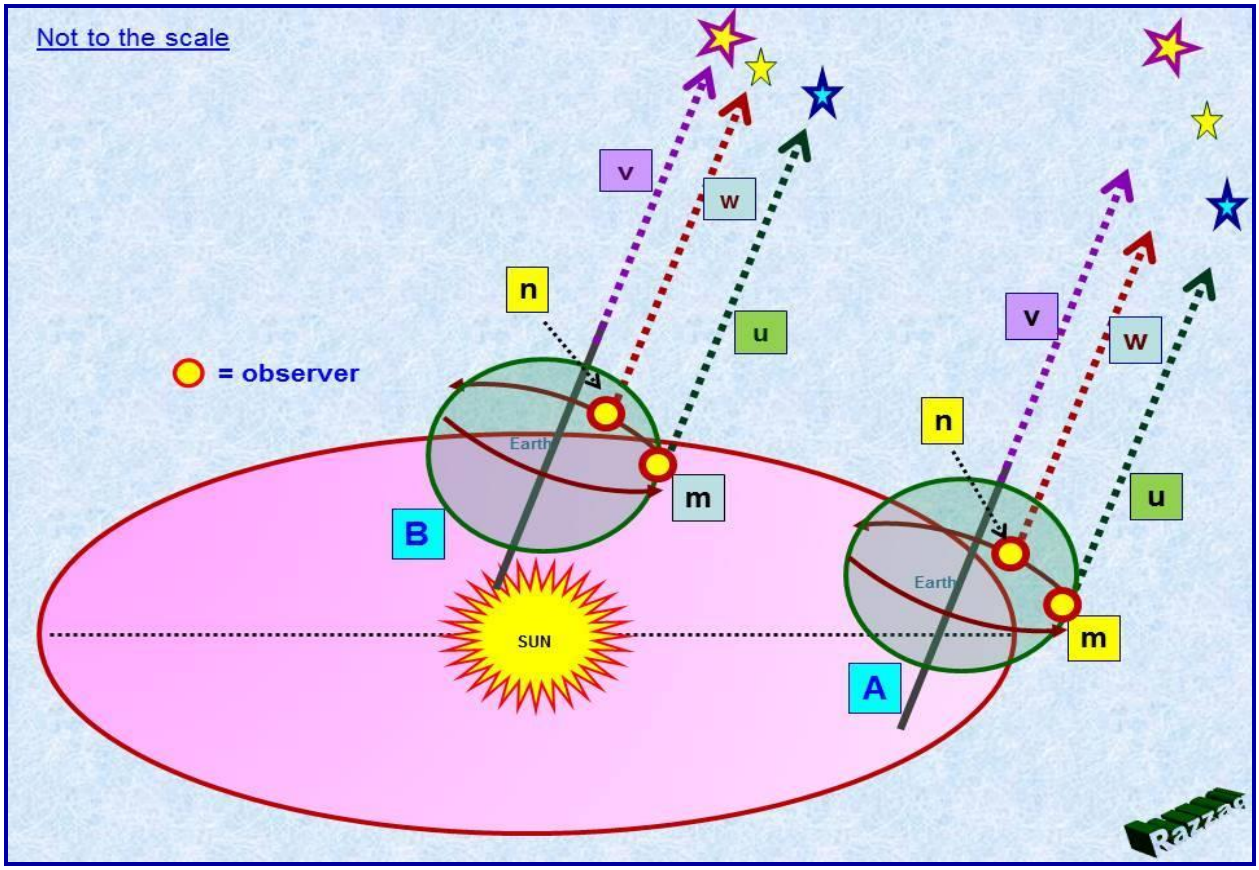

Fig – 4.3: Parallel lines, earth’s rotation, orbital revolution and the reference star. **A, B:** Different positions of the earth in orbit. **m:** Initial position of observer on the earth. **u:** Arrow pointing to a reference star from the observer. **V:** Arrow directing towards the pole star. **n:** Observer after one hour rotation of the earth. **w:** Position of arrow “u” after one hour rotation of the earth.

A small rotation of the earth in one hour will take the observer to position “n”. Assume for the moment that the earth does not move in the orbit. The arrow “u” will acquire the position of arrow “w” but it will be still parallel to the axis or the arrow “v”. However, the observer will notice a shift in the position of the reference star. Although arrow “u” and “w” are parallel but the observer cannot view the reference star at the same position. He will feel that the star has moved clockwise because of anticlockwise rotation of the

earth. Orbital revolution will take the earth from “A” to position “B”. At this position arrow “v” will keep pointing to the pole star and arrow “u” to the reference star. It is surprising that when the observer moves from “m” to “n”, the arrow “w” although remains parallel to arrow “u” and also to arrow “v” but the reference star will not be at the same position to the observer. However, the reference star will remain at the same position relative to the earth at positions “A” and “B” but the observer cannot view the same star at same position when the rotation of the earth takes him from “m” to position “n” although the arrow “u” remains parallel to “v” and “w”. This does not seem logical and rational concept. If the observer moves with rotation of the earth the reference star does not appear at the same position although observer-star lines remain parallel. How the earth remains at the same position relative to the reference star with revolution of the earth in the orbit? Arrows “u” and “v” though remain parallel at different locations of the earth in orbit have no probability to point to the reference star at these positions. The observer should feel a definite shift in position of the reference star with orbital revolution of the earth. Consequently, if the same star appears at the same position throughout the year then orbital revolution of the earth becomes uncertain and ambiguous.

4.1.2 Circular displacement and the reference star

The earth while rotating about its axis comes to the same position with respect to the reference star after completing every rotation. The earth also comes to the same position after completing the orbit. The reference star appears at the same position from all locations of the earth (revisit Fig-4.1). Therefore, it was assumed that as the stars are unimaginably far away from the earth and size of the orbit is small as compared to the distance of the stars so the change in position of the earth in orbit does not create distinguishable difference in the relative positions of the stars in the sky (Dunkin, 2010; Gray, 2008; Snodgrass, 2012). Earth-star lines remain parallel pointing practically to the reference star at all positions of the earth in the orbit (Stachurski, 2009). This means that circular displacement of the earth in orbit is insignificant with respect to the stars. Consequently, the reference star will appear at the same position. Position of the earth in orbit does not matter. Similar assumption has been made to rationalize continuous pointing of earth’s axis to the North Star (Plait, 2002; Rohli and Vega, 2007). Therefore, it can be inferred that as the stars are far away so displacement of the earth with

observer in the orbit cannot produce a change in position of the reference star. Hence it can be hypothesized that:

> ***"If observer-reference-star lines remain parallel then no distinctive displacement of the earth is produced with respect to the reference star and the star will appear at the same position to the observer". In other words "circular displacement should have no effect on appearance of the same star at the same position if observer-star lines remain parallel".***

Suppose northern hemisphere of the earth is cut down. The earth is at position "M" in the orbit, and arrow "p" indicates the direction of axis to the pole star, an observer is at position "a" on the earth and arrow "x1" parallel to arrow "p" is pointing to a reference star "s" (Fig-4.4a).

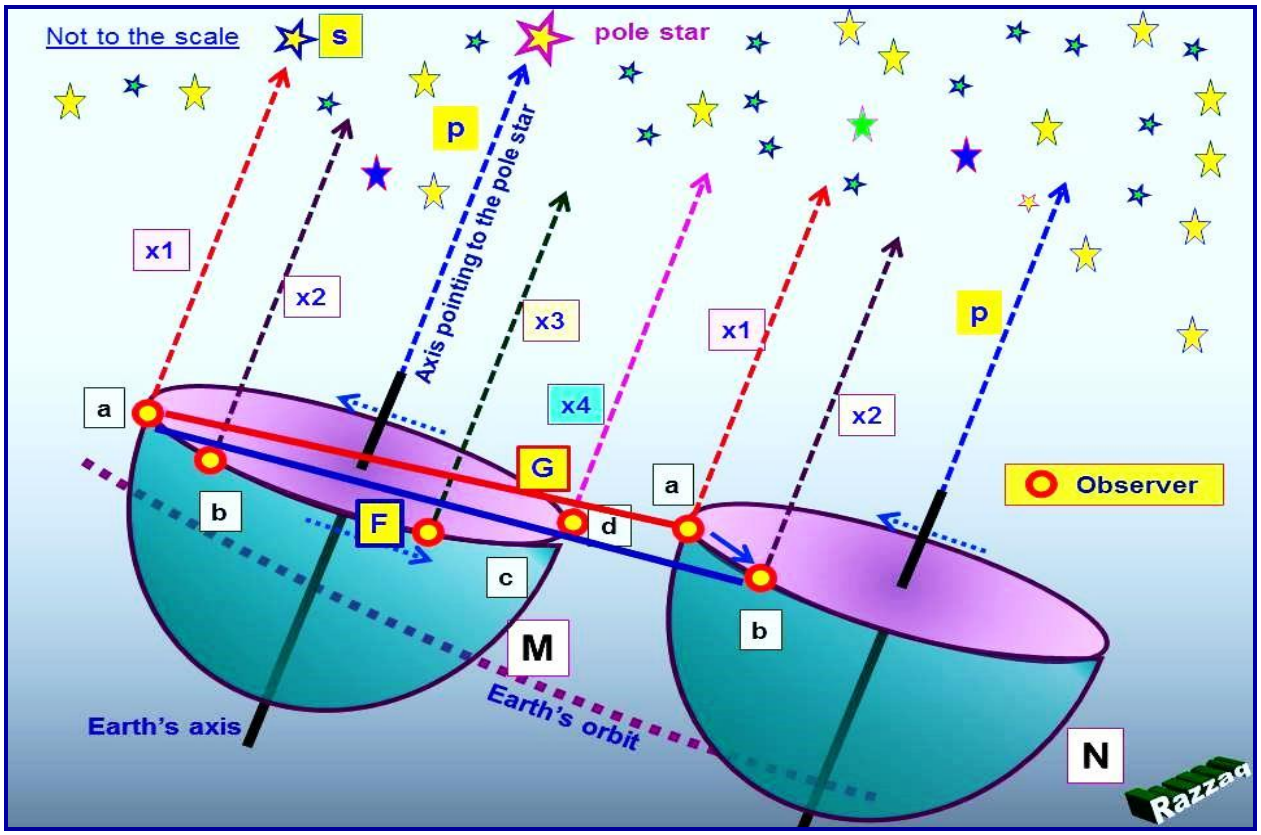

Fig – 4.4a: Circular displacement due to rotation/revolution of the earth and the reference star. **M:** Initial position of the earth in orbit. **p:** Arrow pointing to the pole star, **a:** Initial position of observer on the earth. **s1:** Reference star. **x1:** Arrow parallel to "p" pointing to the reference star from the observer. **b**, **c**, **d**: Different positions of the observer with rotation of the earth. **x2**, **x3**, **x4:** Arrows parallel to arrow x1. **N:** Position of earth in orbit after one hour. **a-b:** Displacement of observer with rotation of the earth. **a-a (red line):** Displacement of the observer due to revolution of the earth. **a-b (blue line):** Net displacement of the observer relative to the reference star due to rotation and revolution of the earth.

Assume that the earth does not move in the orbit. The observer will move to position "b", "c" and "d" with rotation of the earth. The arrows "x2", "x3" and "x4" though remain

parallel to arrows “x1” and “p” cannot point to the reference star “s”. The observer can view the reference star at the same position only after he reaches to position “a” again.

Let the earth rotate for one hour. The position of the observer will change from “a” to “b”. The observer is displaced with respect to the center of the earth. Displacement of the observer relative to the center of the earth in one hour is calculated below:

i) Angular displacement of observer
Rotation of the earth in 1 hour = {(360° ÷ rotation period) x time}
Rotation period = 86164.09053083288 sec
Time = 1 hour = 3600 sec
Rotation in 1 hour = {(360° ÷ 86164.09053083288) x 3600}
= 15.04106864°

ii) Circular displacement of observer from “a” to “b” relative to center of the earth:
Circular displacement (d) = r x θ (in radians)
r = equatorial radius of the earth = 6378.388 km
θ = angular rotation in 1 hour = 15.04106864° = 0.26251617 radians
d = 6378.388 x 0.26251617 = 1674.42998853 km

The observer moves from position “a” to “b” with 15.04106864° axial rotation in one hour. He will not be at the same position with respect to the reference star. The circular displacement of the observer from “a” to “b” is 1674.42998853 km. In other words, the reference star cannot appear at the same position with circular displacement of the observer with respect to the center of the earth although arrow “x2” remains parallel to the arrow “x1”. Change in position of the reference star may be noticed with rotation of the earth in few seconds. Precisely determined rotation period of the earth i.e. 86164.09053083288 seconds (IERS, 2014) indicates that even one second before this period the observer will not be aligned with the reference star. Thus it is inferred that very small rotation of the earth can produce distinctive displacement of the observer with respect to the reference star although observer-star line remains parallel to its original position. The star will not appear at the same position to the observer. Subsequently, the above hypothesis is not approved. It is concluded that circular displacement definitely produces a change in position of the reference star. The assumption, “as the orbit of the earth is small and the stars are far away from the earth therefore at all positions earth-star lines will remain parallel pointing practically to the reference star after every rotation throughout the orbital motion of the earth (Dunkin, 2010; Kirkpatrick and Francis, 2009)” is not valid, logical and scientific. Thus, it may be inferred that circular displacement of observer relative to reference star due to axial

rotation or orbital revolution of the earth should change the angle of view/position of the reference star.

The earth simultaneously rotates and revolves in the orbit. The earth reaches to position "N" from "M" in the orbit in one hour (revisit Fig-4.4a). Orbital displacement of the earth in one hour is calculated below:

iii) Angular displacement of the earth relative to the sun

Revolution of the earth in one hour =

{(360° ÷ revolution period) x time}

Revolution period of the earth = 31556925.25 sec

Time = 1 hour or 3600 sec

Revolution in 1 hour = {(360° ÷ 31556925.25) x 3600} = 0.04106864°

iv) Circular displacement of the earth from "M" to "N" relative to the sun

Circular displacement (d) = r x θ (in radians)

r = radius of earth's orbit = 1.5×10^8 km

θ = revolution of the earth in 1 hour relative to the sun

= 0.04106864° = 0.00071678 radians

Circular displacement (d) = $1.5 \times 10^8 \times 0.00071678 = 107517$ km

When rotation of the earth will take the observer from position "a" to "b" the earth would have revolved 0.04106864° relative to the sun and will be at position "N" with 107517 km circular displacement in the orbit in one hour. Therefore, actual circular displacement of the observer relative to the sun form position "a" to "b" will be net effect of earth's axial rotation and orbital revolution as indicated by blue line "F" in Fig-4.4a. So, it may be deduced that change in position of the observer relative to the star is due to combined effect of axial rotation and orbital revolution of the earth. As circular displacement due to rotation changes position of the reference star therefore orbital displacement of the earth will certainly change the position of the reference star. The reference star cannot be viewed at the same position if the earth changes its position in the orbit. This conclusion can also be elucidated in another way. Suppose the earth is at position "X" in the orbit and the observer is at position "a" on the earth (Fig-4.4b).

Let us assume for a while that the earth rotates about its axis but does not revolve in the orbit. The observer from "a" will move to position "b" after traversing a distance of 1674.42998853 km with 15.04106864°(θe) rotation of the earth in one hour (see

equation-i, ii). Orbital revolution of the earth for equivalent displacement of the observer can be calculated as below:

v) Orbital revolution equivalent to 1674.42998853km due to axial rotation of earth

Angle (θ) subtended by an arc (s) at the center of the sun = s/r radians

Where s = 1674.42998853 km, r = $1.5x10^8$ km (distance of the earth from the sun)

θ = 1674.42998853/$1.5x10^8$ = 0.000011163 radians or 0.00063959°

Time the earth takes to revolve 0.00063959°

= {(revolution period ÷ 360°) x θ

= {(31556925.25 ÷ 360) x 0.00063958} = 56.065261sec

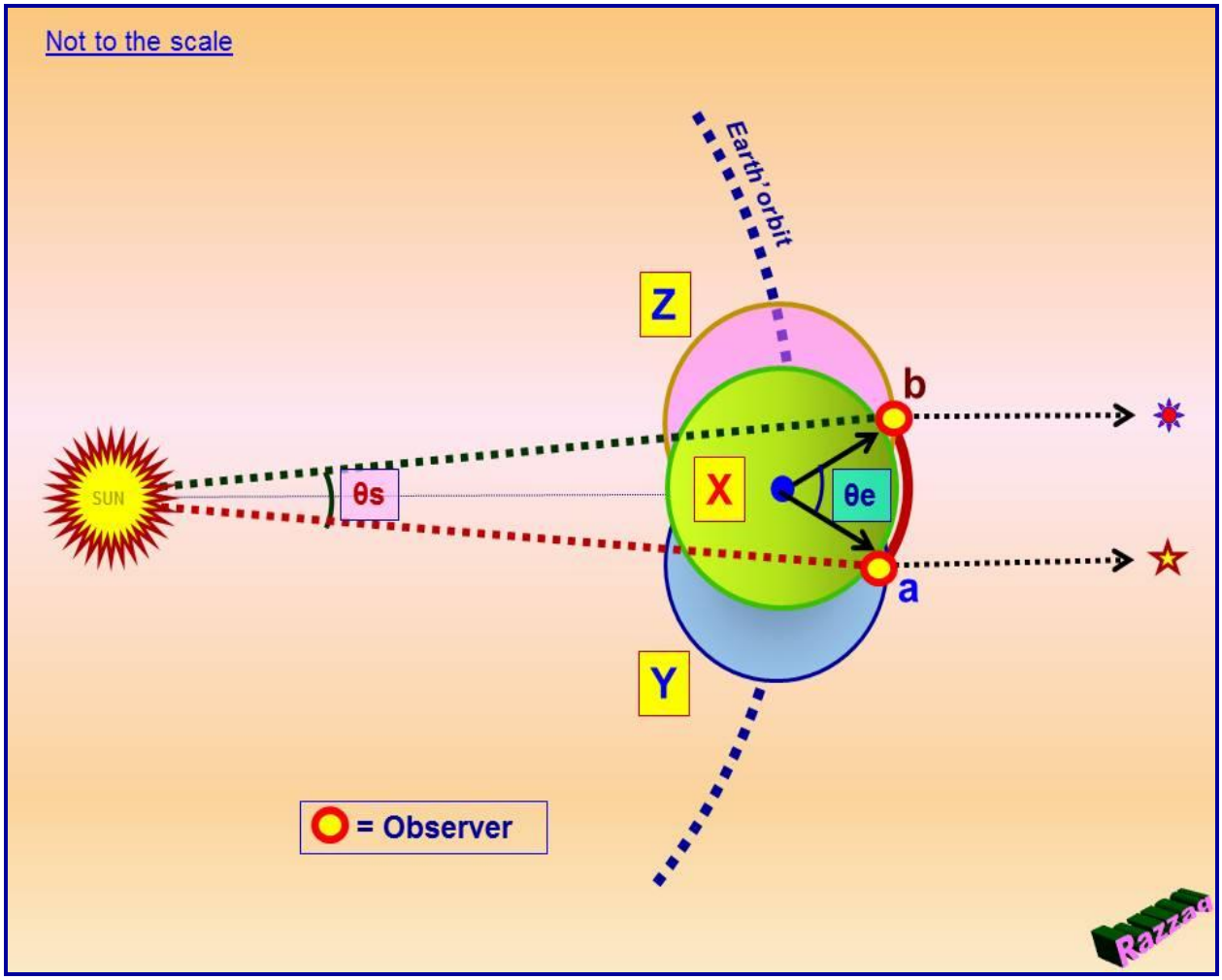

Fig – 4.4b: Circular displacement relative to the sun due to rotation/revolution of the earth. **X, Y, Z:** Positions of the earth in orbit. **a, b:** Positions of the observer on the earth, **θe:** Angle subtended by arc a-b at the center of the earth, **θs:** Angle subtended by arc a-b at the center of the sun.

This means that arc "a-b" of 1674.42998853 km will be subtending an angle of 0.00063958° (θs) with the center of the sun. The earth needs to move from "Y" to "Z" in

56.065261 seconds for equivalent displacement of the observer. It implies that 0.00063959° orbital revolution of the earth is equivalent to 1674.42998853 km circular displacement of the observer due to 15.04106864° axial rotation of the earth. Consequently, 1674.42998853 km circular displacement in orbit because of 0.00063744° revolution of the earth in 56.065261 seconds should have impact on the position of the reference star equivalent to that of 15.04106864° axial rotation. Thus, position of the reference star must change with change in position of the earth in the orbit.

Suppose the earth does not rotate about its axis and just revolves in the orbit. After one hour the observer will be at the same position “a” on the earth. However, he would have been displaced 107517 km (indicated by red line “G” in Fig-4.4a) from his original position relative to the sun. If 1674.42998853 km circular displacement of the observer creates a significant change in position of the star then circular displacement of 107517 km must create a distinctive change in position of the star to the observer. Therefore the assumption “because the distance of the stars is so great that change in position of the earth in orbit makes no sensible difference in position of the stars in the sky (Dunkin, 2010)” is not logical and scientific. This assumption lacks mathematical substantiation and hence cannot be approved. Any star taken as reference appears exactly at the same position after 86164.09053083288 seconds (rotation period relative to the star) and influence of orbital motion of the earth on appearance of the star at the same position after every sidereal day has never been reported. Orbital revolution of earth must affect the position of the reference star. If not then notion of orbital motion of the earth becomes vague and ambiguous.

4.2 Earth’s revolution and the stars

Heliocentric theory assumes that the stars are stationary. Copernicus (1473-1543) postulated that the stars are stationary but seem to move due to rotation of the earth. East to west daily motion of the stars is caused by rotation of the earth about its axis (Ellyard and Tirion, 2008). An important characteristic of the stars is that they have relatively fixed positions with respect to each other i.e. the constellations do not change with time. Consequently, apparent daily motion of the stars should be the net result of axial rotation and orbital revolution of the earth.

4.2.1 Apparent motion of the stars and revolution of the earth

The apparent daily motion of the star is circumpolar i.e. the stars appear to move in concentric circles of different radii, the North Star being at the center (Aaboe, 2001; Millar, 2006) or the stars/constellation appear to revolve about the North Star (Kaufman and Kaufman, 2012). The North Star is immobile. It does not seem to change its position relative to the observer on the earth i.e. it looks stationary. Position of the stars in a constellation relative to the North Star remains same (Tirion, 2011). The stars visible on right side of the North Star relative to the observer during first part of the night cross the line joining the North Star and the zenith, and then move towards the left side. The stars visible on left side appear on the right side of the North Star in last part of the night. This kind of apparent movement of the stars can be observed with naked eyes at night. Motion of one constellation (Big Dipper) is depicted in Fig-4.5 as observed at night from Rawalpindi, Pakistan (33° 40′ North and 73° 08′ East).

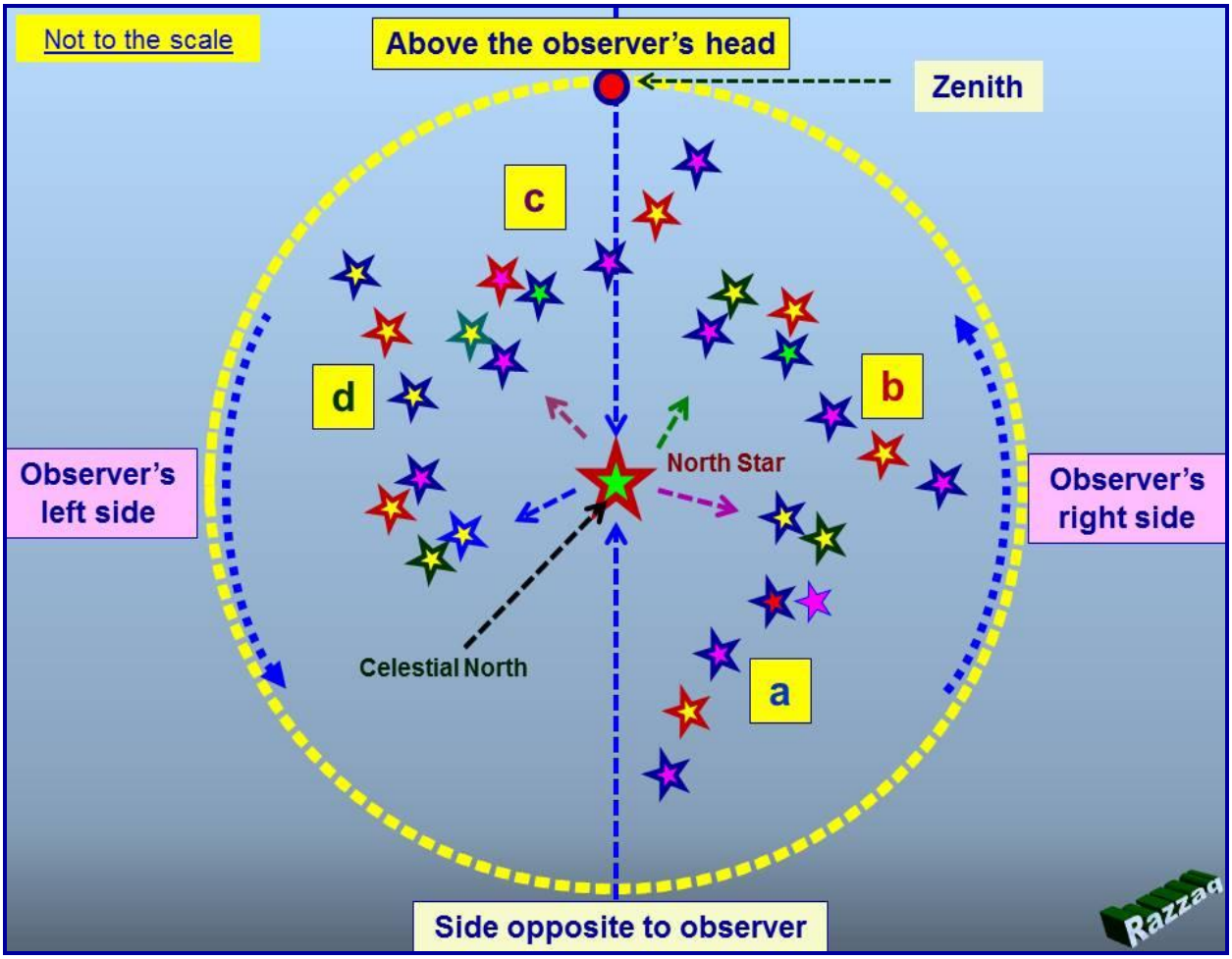

Fig – 4.5: Apparent motion of Big Dipper relative to the North Star. **a, b, c**, **d:** Different positions of Big Dipper relative to pole star and observer on the earth.

This constellation appears on right side of the observer facing North Star at position “a” during early part of night, moves to “b”, crosses the celestial meridian at “c” and then moves to “d” to the left side of the observer. This kind of apparent motion of the stars especially close to North Star can be observed at night. Similarly the stars which appear on left side of the observer during early night will move towards his right side during the later night. According to the assumption of heliocentric model the stars are stationary and appear to move due to axial rotation of the earth while revolving in the orbit. Is the apparent fashion of daily motion of the stars possible if the earth revolves in the orbit while rotating about its axis? This is the question that needs some logical and analytical investigation.

Apparent east to west daily motion of the stars is attributed to earth’s rotation (Ellyard and Tirion, 2008). The earth not only rotates but also revolves around the sun counter clockwise (Shubin, 2011). Therefore, it can be hypothesized that:

> *“Apparent daily motion of the stars should coincide not only with axial rotation but also with orbital revolution of the earth”.*

Let us suppose that the earth is at position “X” in the orbit, the sun is at the center of the celestial sphere, North Star is at the celestial North Pole “N” and the observer is at position “a” on the earth at the start of night (Fig-4.6). The observer views the stars “p” and “q” on right side of the North Star “N” whereas the stars “r” and “s” appear on left side of the North Star after the darkness prevails.

Assume that the stars are visible at night from 8:00PM to 6:00AM, for ten hours. Axial rotation of the earth, circular displacement of the observer on the earth from position “a” to “b” and revolution of the earth in the orbit from position “X” to “Y” during this time is calculated as follows:

i) Angular rotation of the earth in 10 hours:
Angular rotation = {(360° ÷ Rotation Period) x Time}
Time = 10 hours or 36000 sec
Earth’s rotation period = 86164.09053083288 sec
Rotation during 10 hours = {(360° ÷ 86164.09053083288) x 36000}
= 150.41068640° or 2.62516171 radians

ii) Circular displacement of the observer:
Circular displacement = r x θ,
r (radius of the earth) = 6378.388 km, θ = 2.62516171 radians
Circular displacement = 6378.388 x 2.62516171 = 16744.29994912 km

iii) Orbital revolution in 10 hours:

Earth's revolution period = 31556925.25 sec

Orbital revolution of the earth = {(360° ÷ Revolution Period) x Time}

= {(360 ÷ 31556925.25) x 36000} = 0.410686399°

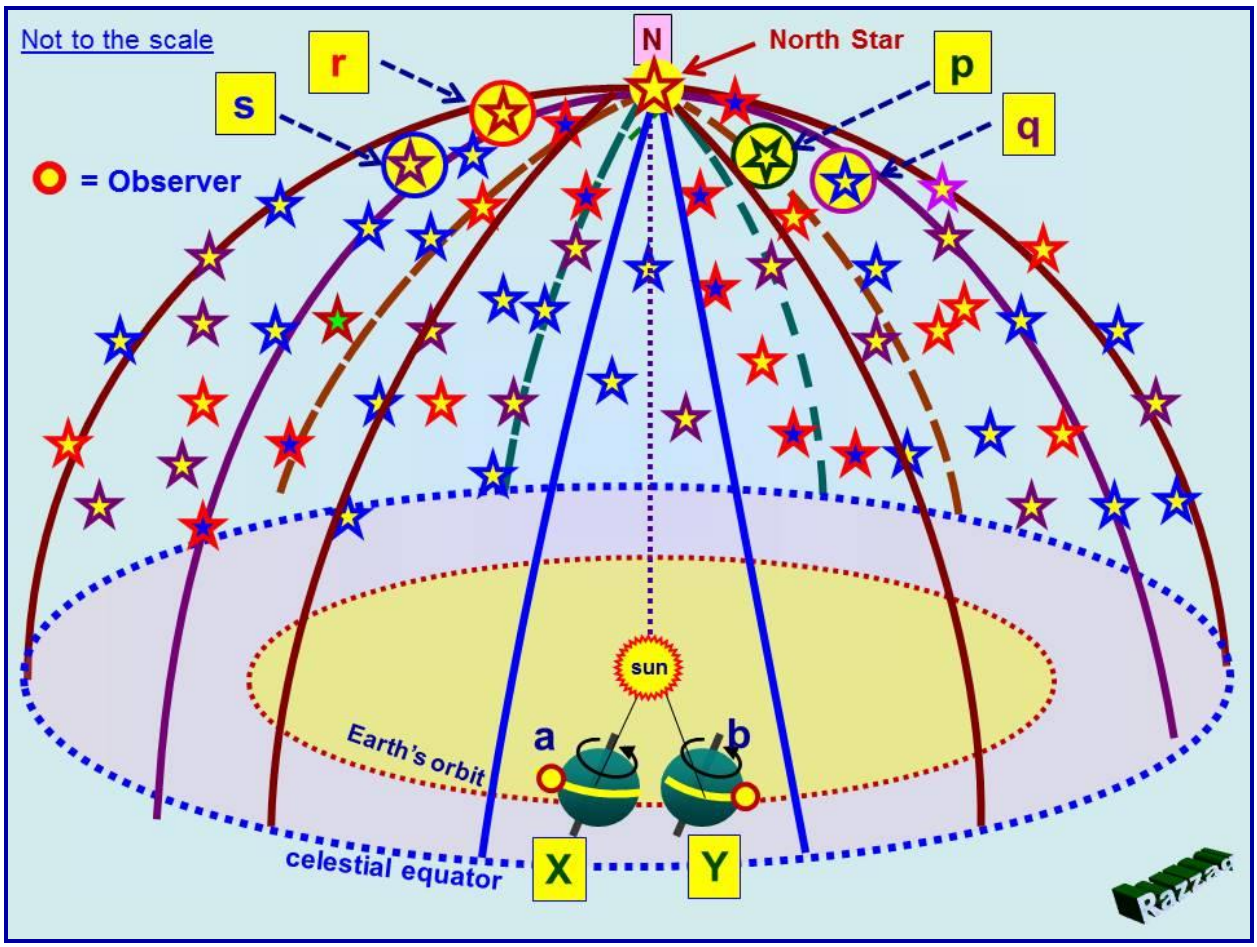

Fig – 4.6: Rotation/revolution of the earth and apparent motion of the stars. **N:** North Star. **X:** Initial position of the earth in orbit. **Y:** Position of the earth after 10 hours. **a:** Initial position of observer at the start of night. **b:** Position of the observer after ten hours rotation and revolution of the earth. **p, q:** Reference stars on right side of the observer. **r, s:** Reference stars on left side of the observer.

As the earth rotates 150.41068640° during ten hours at night the observer will be displaced 16744.29994912 km from his initial position "a" to "b" on the earth whereas the earth will revolve only 0.410686399° relative to the sun from "X" to "Y". If the stars (or celestial sphere), according to the postulate of heliocentric model, are stationary (Koupelis, 2010) and just look moving due to axial rotation of the earth then there is no probability for the stars "p" and "q" to transit the celestial meridian and go to the left side of the North Star. Similarly, the stars "r" and "s" cannot appear on right side of the North Star due to displacement of observer from "a" to "b" with rotation and revolution of earth in this time. Therefore, it becomes evident that axial rotation and non-centric mobile

position of the earth cannot justify the apparent daily motion of the stars conflicting with the above said hypothesis. Followings are the three possibilities to rationalize the observed pattern of daily motion of stars:

a- First possibility is that the earth completes one revolution around the sun every 24 hours. Look at the hypothetical plane view of celestial sphere (Fig-4.7). At position “W” of the earth in orbit the reference stars “p” and “q” are on right side while the stars “r” and “s” are on left side of the observer relative to the North Star. When the earth moves to position “X”, rotation of the earth will take the observer to position “b” so the stars “p” and “q” will appear in between the observer and the North Star. At position “Y” of the earth in orbit the observer will go to “c” due to earth’s rotation. Now the observer will view the stars “p” and “q” on left side and the stars “r” and “s” on right side of the North Star. When the earth will go to position “Z” in orbit the stars “r” and “s” will be in between the observer and the North Star during some time of the day. Thus the observed fashion of motion of the stars necessitates that the earth should go to different positions in the orbit and complete one revolution in 24 hours (one day). Nonetheless, the earth completes one revolution in about 365.2422 days (Crystal, 1994) and does not complete one revolution in 24 hours. Therefore, this possibility is ruled out.

b- Second possibility is that the celestial sphere rotates clockwise once every 24 hours or the stars move around the North Star. Revisit Fig-4.6 and imagine clockwise rotation of celestial sphere. Clockwise rotation of celestial sphere will bring the stars “p” and “q” in between the observer and the North Star and then they will move to the left side of the observer. Similarly, the stars “r” and “s” will come to right side of the observer with rotation of the celestial sphere. Nonetheless, the stars are considered stationary in heliocentric model. Acceptance of this possibility will deny the postulate of heliocentric theory about the stars. Therefore, this possibility is also unacceptable.

c- Position of the earth in the center of celestial sphere is the third possibility to validate the apparent pattern of motion of the stars. Suppose the earth is in the center of the celestial sphere (Fig-4.8). The reference stars “p” and “q” are on the right side of the observer at position “a” on the earth whereas the stars “r” and “s” are on his left side. When the observer moves from position “a” to “b” due to rotation of the earth the stars “p” and “q” will come in between the observer and the North Star and then move to his

left side. Similarly the stars “r” and “s” will appear to move and come on right side of the observer in later part of the night. The reference stars will appear to move clockwise around the North Star in accordance with the observation (Major, 2013). The earth completes one axial rotation in one sidereal day (Louis and Ippolito, 2008) in anti-clockwise direction so the stars appear to move clockwise and the same star appears at the same position after sidereal day. The North Star positioned at the celestial north coinciding with the terrestrial north will not appear to change its position due to rotation of the earth. Nonetheless, acceptance of this possibility will deny central position of the sun and orbital revolution of the earth thereby contradicting with postulates of heliocentric model. Therefore, this possibility is also denied.

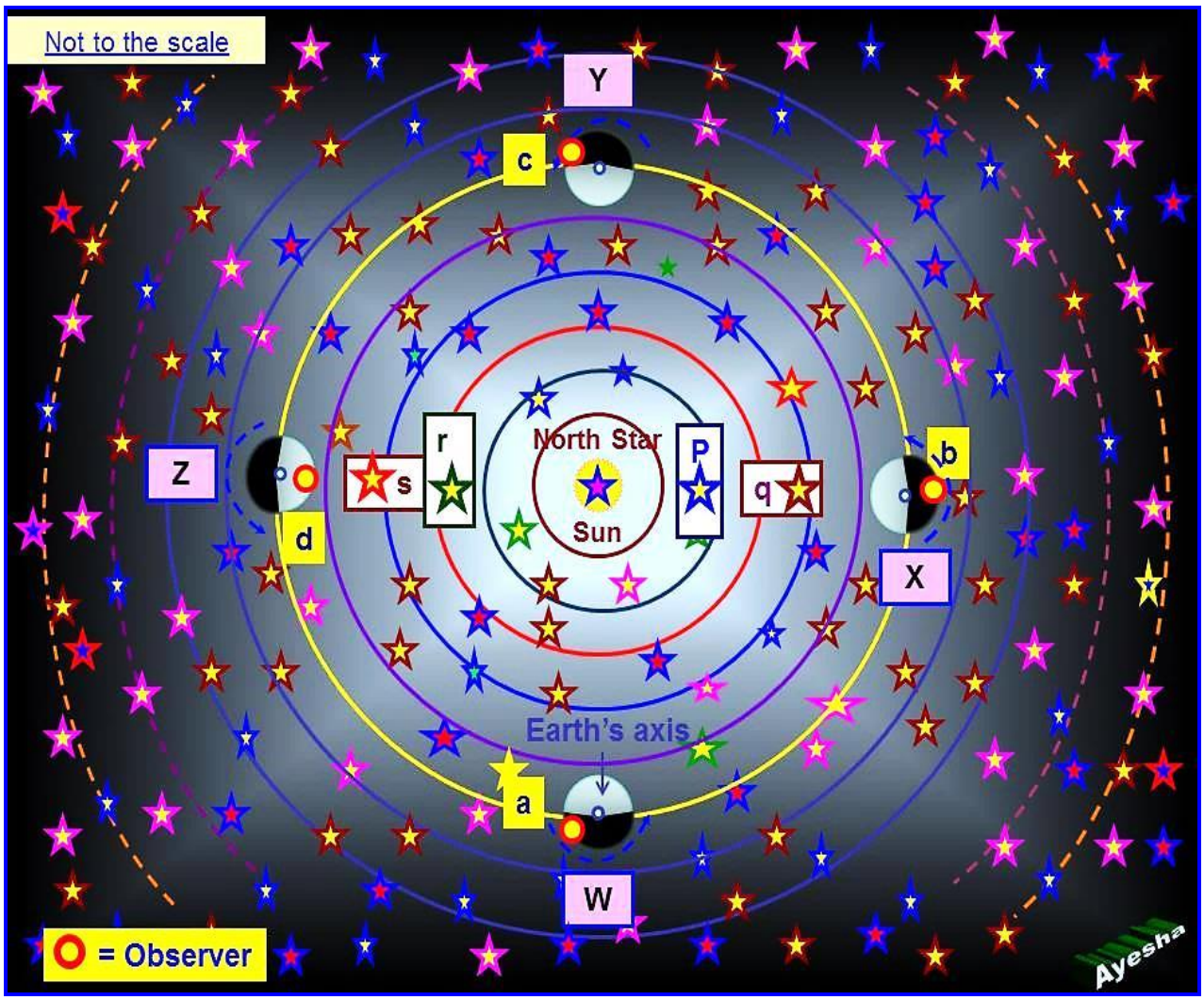

Fig – 4.7: Hypothetical plane view of the celestial sphere. **W, X, Y, Z:** Different locations of the earth in orbit. **a, b, c**, **d:** Positions of the observer on earth at different times. **p, q:** Reference stars on right side of the North Star, **r, s:** Reference stars on left side of the North Star to the observer at “a” on earth at location “**W**” in the orbit.

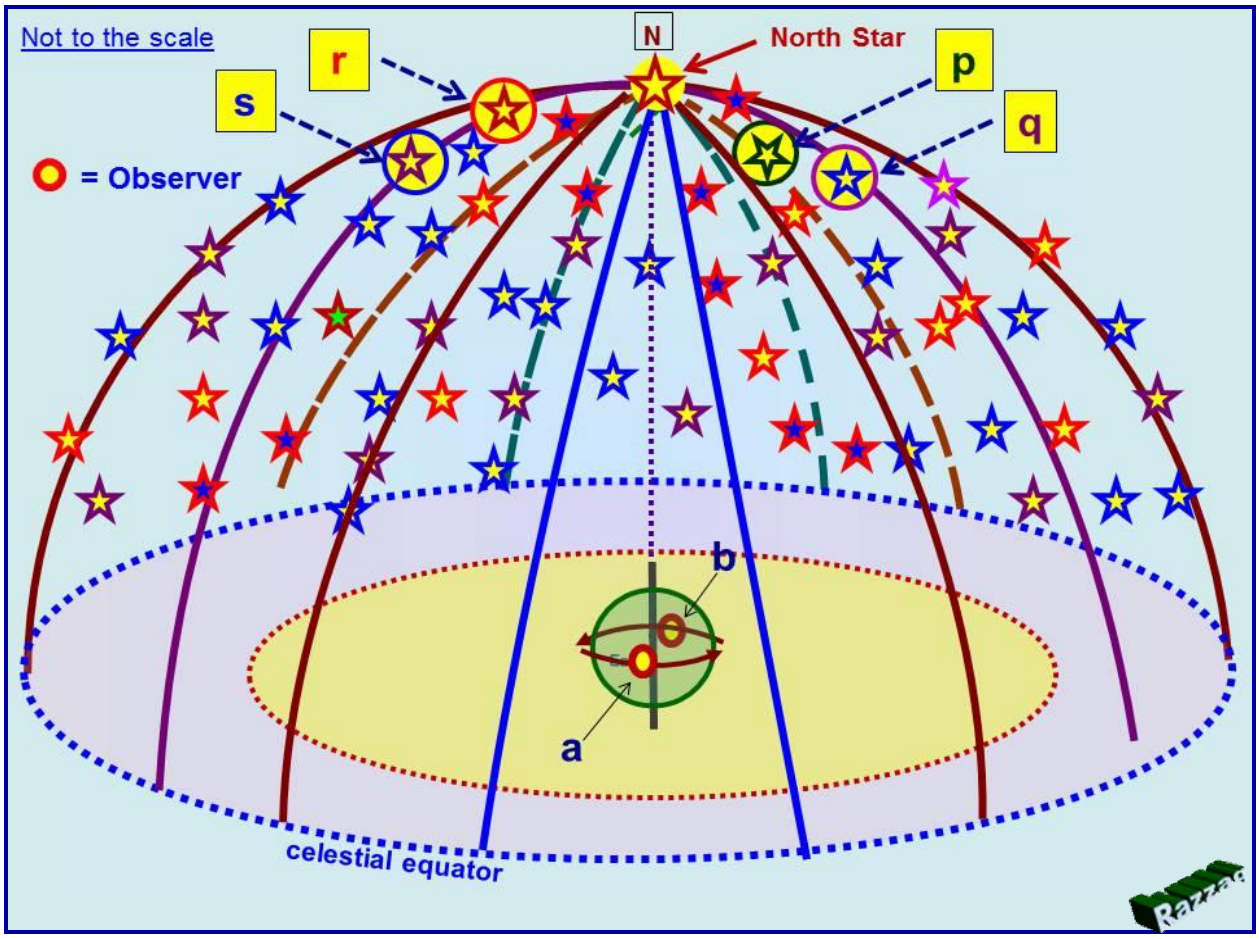

Fig – 4.8: The earth in the center of celestial sphere and apparent motion of the stars. **a:** Position of the observer at the start of the night. **b**: Position of the observer at the end of the night. **p, q:** The stars on the right side of the observer at "**a**". **r** and **s:** The stars on left side of the observer at position "**a**".

Thus, it can be inferred that the observed fashion of daily motion of the stars does not correlate with non-centric mobile position of the earth. Axial rotation of the earth with simultaneous orbital revolution has no possibility to validate apparently observed daily motion of the stars. So the above mentioned hypothesis is rejected. Consequently it is inferred that heliocentric model has no competence to explain the apparent daily motion of the stars. Therefore, heliocentric apprehension of the solar system seems uncertain and suspicious.

4.2.2 Visibility of the stars in winter and summer

It has been assumed in heliocentric model that the stars are stationary but they appear to move due to axial rotation of the earth. There is no probability for the stars that appear on the right side of the observer to be viewed in between the observer and the North Star and then to the left side of the observer if the earth revolves in the orbit while

rotating about its axis. This has been discussed in previous section. The earth revolves in the orbit and completes one revolution in about 365.2422 days (Capderou, 2005). In about six months (182.6211 days) the earth while moving in the orbit will go to the opposite side of the sun but the stars being stationary will stay at their original position.

Suppose the earth is at position “X in the orbit, an observer at 12:00 o’clock midnight while facing the North Star is standing at position “a” on the earth, “s1” and “s2” are the two stars in between the observer and the North Star (Fig-4.9). The star “s1” is towards the observer and the star “s2” towards the North Star. The earth will go to position “Y” in the orbit after about six months.

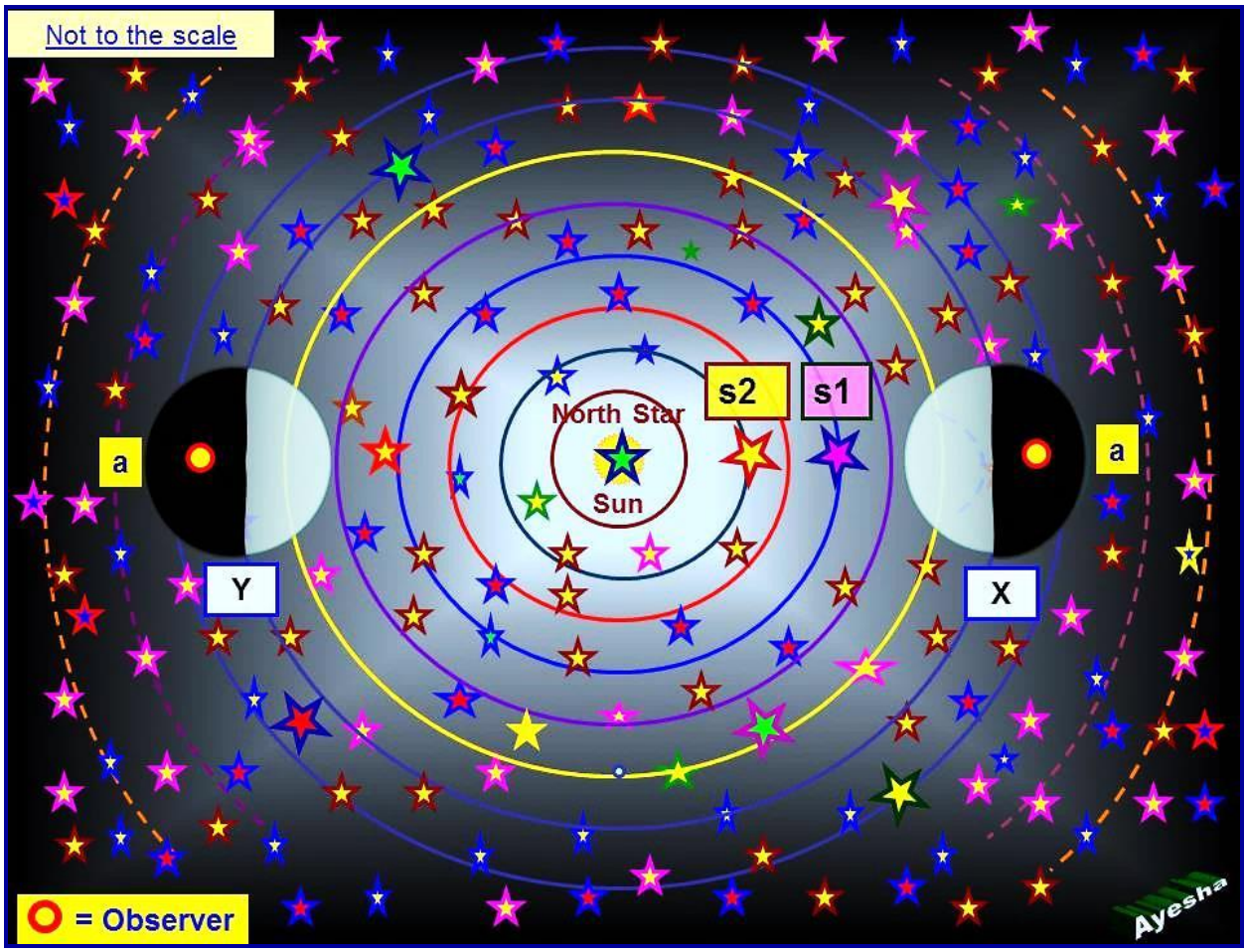

Fig – 4.9: Plane view of celestial sphere and visibility of stars in summer and winter. **X:** Initial position of the earth in the orbit, **a:** Position of the observer on the earth. **s1, s2:** The reference stars in between the North Star and the observer. **Y:** Position of the earth in orbit after about six months.

At 12:00 o’clock midnight while facing the North Star the observer standing at the same position cannot find the reference stars at the same position. There is absolutely no

possibility of the “s1” and “s2” to appear in between the observer and the North Star if the earth goes to the other side of the sun after about six months. The observer may be able to view the same stars on other side of the North Star. Now the North Star will be towards the observer, followed by the reference star “s2” and then “s1”.

Therefore, it may be theorized that:

> ***“The scenario of the sky must change completely after about six months if the earth revolves in the orbit. None of the stars which appear in between the observer and the North Star has any probability to be viewed at the same position after six months”.***

However, the observation does not conform to the anticipated position of the reference stars if the earth simultaneously rotates about its axis and revolves in the orbit. Any star may be taken as reference star. However the stars near the pole star are more appropriate for the reference. The same star can be viewed in between the North Star and the observer for several months. For instance, the time Big Dipper crosses the celestial line (the line joining the North Star and the zenith) as observed from Rawalpindi (33° 40′ North and 73° 08′ East), Pakistan presented in Table-4.1 reveals that this constellation can be viewed at the same position for about six months, from December to May. After May 15 it is not possible to note the time this constellation crosses celestial line due to twilight. Nonetheless, the big dipper can be viewed on the left side of the celestial line after the darkness prevails indicating that the constellation has just crossed the celestial meridian. Appearance of the same star/constellation on the celestial meridian in front of the observer for about six months implies that scenario of the sky does not change completely.

Similar observation has been reported in literature. The scenario of the sky does not change altogether. The same stars appear throughout the year (Aaboe, 2001; Millar, 2006; Oster, 1973) at the same position though at different times. This observation is against the above hypothesis and cannot be explained if the earth is assumed orbiting the sun. Consequently the above hypothesis is rejected. Thus, appearance of the reference stars at the same position for several months does not correspond to orbital motion of the earth and stationary stars. Orbital revolution of the earth and stationary stars cannot make the same stars/constellation appear at the same position continuously for several months. It is logically and scientifically not possible. As a result,

it can be concluded that either the stars also move and/or the earth does not revolve around the sun. Hence, scientific validity of heliocentric model becomes uncertain.

Table – 4.1: Time the Big Dipper crosses the celestial line as observed from Rawalpindi 33° 40/ North and 73° 08/ East, Pakistan

Date	Transit Time (PST*)
December 8, 2008	06:12
January 11, 2009	03:58
February 8, 2009	02:08
March 15, 2009	23:50
April 21, 2009	21:25
May, 2009	19:50

* Pakistan Standard Time

4.3 Conclusion

Critical and mathematical analysis of orbital revolution of the earth reveals that the assumptions of heliocentric model are not valid scientifically and mathematically. Earth-star parallel lines cannot keep the reference star at the same position all along the orbit. Circular displacement of the earth must produce change in position of the reference star contrary to the assumption of heliocentric model. If not then authenticity of heliocentric model is ambiguous. Apparent motion of the stars does not correlate with non-centric mobile position of the earth in orbit. The evidences provided here prove scientifically and logically that heliocentric comprehension is not plausible explanation of solar system but inappropriate and illusive apprehension of solar system.

CHAPTER 5

5 MOON, ARTIFICIAL SATELLITES AND ORBITAL REVOLUTION OF THE EARTH

The moon is the only natural satellite of the earth. Distance of the moon from the earth is about 3.84×10^5 km (Lang, 2012). The moon while rotating about its axis revolves around the earth in anti-clockwise direction under the influence of gravitational force from the earth with a speed of about 1.023 km/s (Lang, 2012). The moon revolves around the earth that rotates about its axis and also revolves around the sun with a speed of 30 km/s. The moon remains in the company of the earth in orbit around the sun. The moon returns to the same position relative to the stars after completing 360° revolution in 27.32166155 days (IERS, 2014) called as sidereal month or moon's sidereal period of revolution whereas it completes revolution relative to the sun (synodic period) in 29.530589 days (Moore and Rees, 2014) or 29 days, 12 hours, 44 minutes and 2.78 seconds or 2551442.78 sec (Williams, 2009).

5.1 Moon and earth's orbital revolution

The moon while rotating about the axis and revolving around the earth that itself orbits the sun is under the influence of different forces and exhibit various motions as mentioned below:

The moon

1- Rotates about its axis
2- Revolves around the earth
3- Moves with the earth in the orbit around the sun

Moon is under the influence of

1- Gravitational force from the earth
2- Gravitational force from the sun
3- Force causing the moon to rotate

Different forces acting on the moon and directions of motion while revolving in the orbit and moving with the earth are depicted in Fig-5.1. The moon while orbiting the earth needs to move with the earth that is revolving around the sun. The moon at position "A" is under the influence of gravitational pull from the earth ("Ge") and the sun ("Gs") in opposite directions. Moon rotates about the axis ("m1"), moves anticlockwise in its orbit ("m3") and also moves with the earth ("m2") with different speeds in opposite directions simultaneously. At positions "B" & "D" direction of motion of the moon in company of the

earth (“m2”) will be perpendicular to its revolution around the earth “m3”. The earth will be dragging the moon at “B” and pushing it at “D”. Gravitational pull “Gs” from the sun will be acting perpendicular to that from the earth both at “B” and “D”. At position “C” the moon’s orbital motion “m3” and its motion with the earth “m2” will be in same direction. Gravitational pull from the sun and the earth, at this position, will be acting in the same direction. In spite of different forces acting in different directions the moon revolves smoothly and remains linked with the earth orbiting the sun. How does the moon while orbiting the earth remain linked with the earth orbiting the sun? Insight of literature reveals that three different concepts have been proposed to perceive the motion of the moon around the earth that itself orbits the sun. These concepts are briefly described and discussed in the following pages to assess their validity.

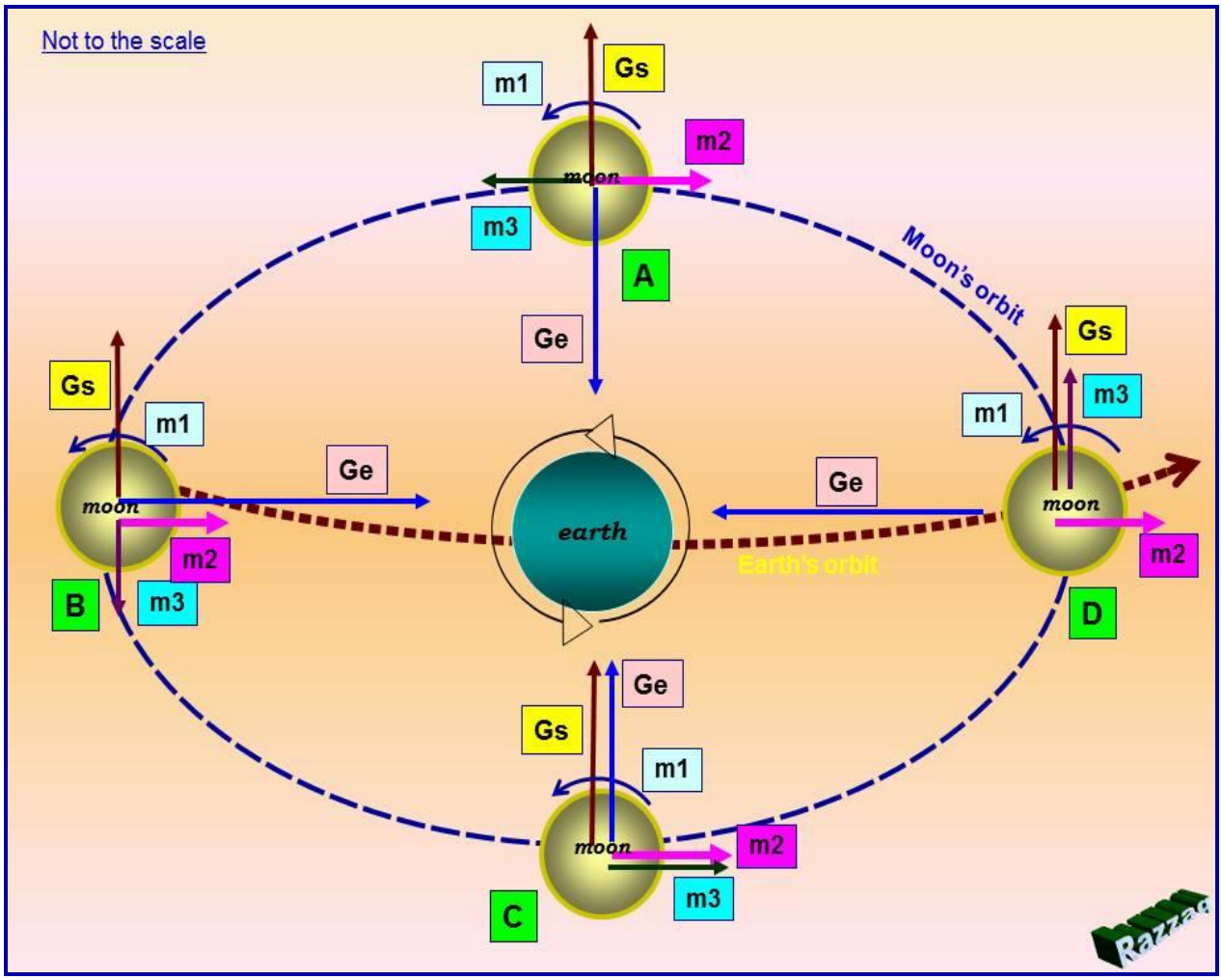

Fig-5.1: Different forces acting on the moon and its motions. **A, B, C, D:** Moon at different locations in the earth. **Ge:** Gravitational force from the earth. **Gs:** Gravitational force from the sun. **m1:** Axial rotation of the moon. **m2:** Direction of motion of the moon in orbit of the earth. **m3:** Direction of orbital revolution of the moon.

5.1.1 Double planet system

The moon does not revolve around the sun independently but indirectly it keeps revolving around the sun. The earth and the moon move together as a pair and behave as independent planets revolving in the elliptical orbits around the sun i.e. the earth and the moon make a binary or double planet system (Akulenko et al., 2005; Bloomfield, 2001). The earth and the moon are held together by mutual gravitational force (Reddy, 2001) that is responsible for orbital revolution of the moon around the earth and keeping the moon linked with the earth throughout their motion around the sun. The orbit of the moon will have loops or zigzag shape (Lowrie, 2007) www.math.nus.edu.sg/aslaksen/).

The above concepts elucidate that the earth and the moon are two planets that remain together due to mutual gravitational force. Suppose the earth is at position "1" in the orbit and the moon is at position "x" in its looped path (Fig-5.2A). The earth and the moon will be moving in the same direction.

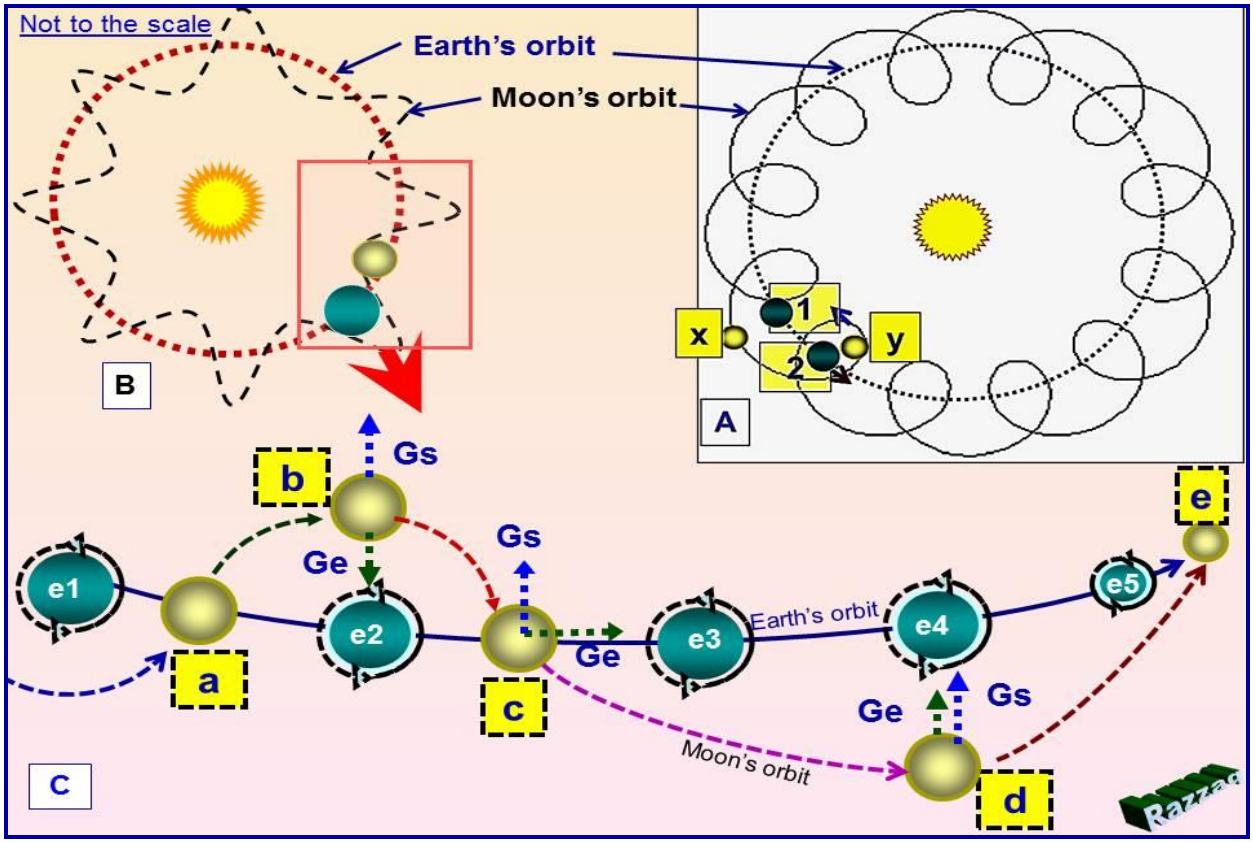

Fig – 5.2: Looped and zigzag shapes of moon's orbit. **A:** Looped shape orbit. **1, 2:** Positions of the earth in orbit. **x, y:** Different locations of the moon in the loop. **B:** Zigzag shape of moon's orbit. **C:** Zoomed segment of zigzag orbit. **a, b, c, d, e:** Different positions of the moon in zigzag orbit. **e1, e2, e3, e4, e5:** Earth at different locations in the orbit. **Ge:** Gravitational force from the earth. **Gs:** Gravitational force from the sun.

At position “2” of the earth the moon will be at position “y”. The moon and the earth will be moving in opposite directions. The earth needs to stand still in the orbit till the moon completes its motion in the loop or moon should have orbital speed significantly greater than that of the earth for this kind of looped motion (Goulding, 1872). How the moon moving with speed of 1.023 km/s (Lang, 2012) will remain linked with the earth that moves with a speed of 30 km/s in the orbit? There is no scientific explanation of this concept. So the concept of looped shaped orbit of the moon is not logical and scientific.

Alternately, the moon may be moving as a planet in the orbit of the earth in a zigzag pathway (Lowrie, 2007). Zigzag motion of the moon is depicted in Fig-5.2B. Suppose the earth is at position “e1” in the orbit and the moon is at position “a” in zigzag pathway (Fig-5.2C). The moon needs to be at positions “b”, “c”, “d” and “e” corresponding to the earth at positions “e2”, “e3”, “e4” and “e5” in orbit, respectively. Obviously, the moon has to move with different speeds for this purpose. The moon needs speed greater than the earth for this kind of zigzag orbital motion (Goulding, 1872). Scientifically, it is not possible to explain this kind of motion of the moon around the earth. Hence this idea of moon’s zigzag orbital shape does not seem rational.

Additionally, if the idea of moon’s zigzag orbit is supposed true then the concept that the moon revolves anticlockwise around the earth will be refuted. Consider the motion of the moon from position “a” to “b” and then to “c” in the zigzag orbit while the earth is at point “e2” (revisit Fig-5.2). Direction of motion of the moon will be clockwise as it will be moving in the direction opposite to anticlockwise rotation and revolution of the earth. However, direction of motion of the moon from “c” to position “d” and “e” will coincide with anticlockwise rotation and revolution of the earth. Therefore, the moon must be alternating its direction of revolution from clockwise to anticlockwise and vice versa. Consequently, the idea of zigzag orbital pathway of the moon is just theoretical and imaginary without any scientific reality.

5.1.2 Gravitational forces and the moon

The earth and the moon are considered a double planet system held together by mutual gravitational force (Reddy, 2001). The earth and the moon form a single system bound together by gravity (Hecht, 2003). This gravitationally bound system revolves in the orbit around the sun under the gravitational force from the sun (Bloomfield, 2001). Let us assume that this assumption is correct then the law of gravitation (Giordano, 2012) must substantiate this concept.

Direction of gravitational forces from the sun and the earth acting on the moon at different positions in the orbit are depicted in Fig-5.3. The moon at “b” is in between the sun and the earth at position “e2” (revisit Fig-5.2c). So, the moon will be under the effect of gravitational forces from the sun and the earth in opposite directions (Fig-5.3A).

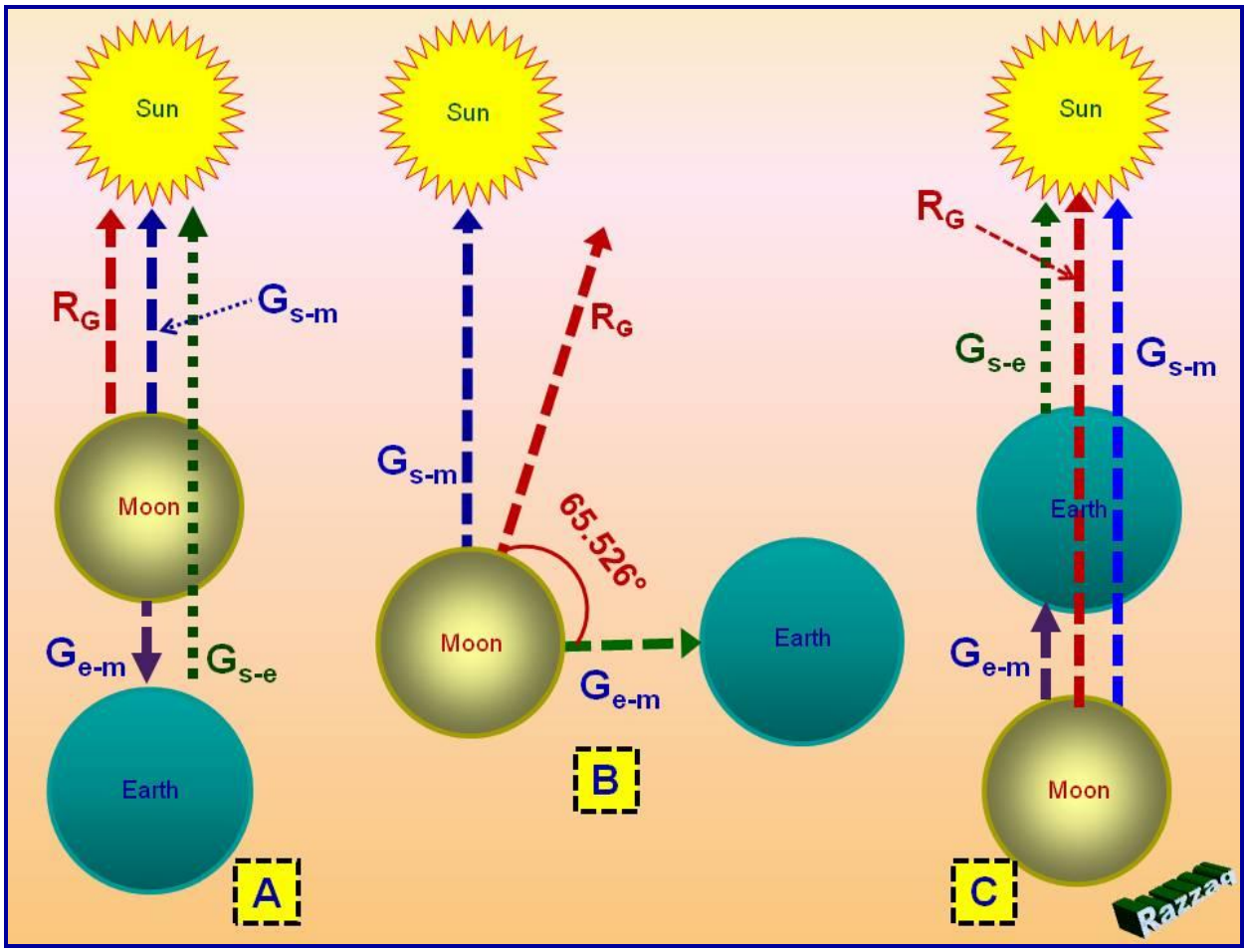

Fig – 5.3: Gravitational forces and the moon. **A:** The moon between the earth and the sun. G_{e-m}**:** Gravitational force on the moon from the earth. G_{s-e}**:** Gravitational force of the sun on the earth. G_{s-m}**:** Gravitational force of the sun on the moon. R_G**:** Net gravitational force on the moon. **B:** The earth and the sun at right angle relative to the moon. **C:** Earth between the moon and the sun.

Magnitude of gravitational forces from the sun on the earth and on the moon, and that of the earth on the moon in this situation is calculated below:

i- Gravitational force from the sun on the earth ($F_{sun\text{-}earth}$)

$F_{sun\text{-}earth} = [(G. M_{earth}. M_{sun}) \div (R_{sun\text{-}earth})^2]$

$= [(6.67x10^{-11} \times 6.0x10^{24} \times 2.0x10^{30}) \div (1.50x10^8 \times 10^3)^2] = \underline{3.56x10^{22}\ N}$

M_{sun} (mass of the sun) = $2.0x10^{30}$ Kg, M_{earth} (mass of earth) = $6.0x10^{24}$ Kg

$R_{sun\text{-}earth}$ (distance of the sun from the earth) = $1.50x10^8 x10^3$ m,

G (gravitational constant) = $6.67x10^{-11}$ Nm2/Kg^2

ii- Acceleration of gravity in the earth due to the sun ($g_{s\text{-}e}$)

Acceleration due to gravity, $g_{(s\text{-}e)} = [G. M_{sun} \div (R_{sun\text{-}earth})^2]$

$= \{(6.67x10^{-11} \times 2.0x10^{30}) \div (1.50x10^{11})^2\} = \underline{5.93x10^{-3}\ m/s^2}$

iii- Gravitational force from the sun on the moon ($F_{sun\text{-}moon}$)

$F_{sun\text{-}moon} = [(G. M_{moon}. M_{sun}) \div (R_{sun\text{-}moon})^2]$

$F_{sun\text{-}moon} = [(6.67x10^{-11} \times 7.0x10^{22} \times 2.0x10^{30}) \div (1.496x10^{11})^2] = \underline{4.172x10^{20}\ N}$

M_{moon} = $7.0x10^{22}$ Kg, $R_{sun\text{-}moon} = 1.496x10^8$ Km or $1.496x10^{11}$ m ($R_{sun\text{-}earth} - R_{earth\text{-}moon}$)

iv- Acceleration of gravity in the moon due to the sun ($g_{s\text{-}m}$)

Acceleration due to gravity $g_{(s\text{-}m)} = [G. M_{sun} \div (R_{sun\text{-}moon})^2]$

$= [(6.67x10^{-11} \times 2.0x10^{30}) \div (1.496x10^8 x10^3)^2] = \underline{5.96x10^{-3}\ m/s^2}$

v- Gravitational force from the earth on the moon ($F_{earth\text{-}moon}$)

$F_{earth\text{-}moon} = [(G. M_{earth} . M_{moon}) \div (R_{earth\text{-}moon})^2]$

$R_{e\text{-}m} = 3.84x10^5$ Km or $3.84x10^8$ m

$F_{e\text{-}m} = [(6.67x10^{-11} \times 6.0x10^{24} \times 7.0x10^{22}) \div (3.84x10^8)^2] = \underline{1.899x10^{20}\ N}$

vi- Acceleration of gravity in the moon due to the earth ($g_{e\text{-}m}$)

$g_{(e\text{-}m)} = [G. M_{earth} \div (R_{earth\text{-}moon})^2]$

$= [(6.67x10^{-11} \times 6.0x10^{24}) \times (3.84x10^8)^2] = \underline{2.714 \times 10^{-3}\ m/s^2}$

vii- Net gravitational force on the moon (R_G)

Gravitational force from the sun on the moon = $4.172x10^{20}$ N

Gravitational force from the earth on the moon = $1.899x10^{20}$ N

Net gravitational force on the moon = $4.172x10^{20} - 1.899x10^{20} = \underline{2.273x10^{20}\ N}$

viii- Net acceleration produced in the moon

Acceleration due the sun = $5.96x10^{-3}$ m/s^2

Acceleration due to the earth = 2.714×10^{-3} m/s^2

Net acceleration produced in moon = $5.96x10^{-3} - 2.714 \times 10^{-3} = \underline{3.246 \times 10^{-3}\ m/s^2}$

Mathematical calculations reveal that the moon should experience a net force of $2.273x10^{20}$ N directed towards the sun when present in between the earth and the sun. So the moon is expected to accelerate at the rate of 3.246×10^{-3} m/s^2 towards the center of the sun. Gravitational force of $3.56x10^{22}$ N exerted on the earth by the sun produces acceleration of $5.93x10^{-3}$ m/s^2. Consequently, the earth has to revolve around the sun with a speed of 30km/s to balance this force. The moon when present in between the sun and the earth experiences net force of $2.273x10^{20}$ N that can produce acceleration of $3.246x10^{-3}$ m/s^2 towards the center of the sun. Therefore, the moon is expected to accelerate towards the sun and there is no probability for the moon to revolve around the earth. How is this possible that the moon will be moving in a zigzag pathway along with the earth in orbit? No law of physics can explain and validate this idea of zigzag pathway of moon along the orbit of the earth. Thus, the idea of binary/double planet system (Bloomfield, 2001) held together by mutual gravitational force (Reddy, 2001) that is responsible for orbital revolution of the moon around the earth and keeping the moon linked with the earth in the orbit is not logical. This concept is hypothetical and imaginary without any scientific basis.

While orbiting the earth the moon goes to position "c" and the earth will be at position "e3" in the orbit (revisit Fig-5.2C). Both the sun and the earth will be at right angle with respect to the moon. Gravitational force from the sun on the moon ($G_{s\text{-}m}$) will be perpendicular to that from the earth on the moon ($G_{e\text{-}m}$) as is shown in Fig-5.3B. Magnitude of these gravitational forces due to the sun and the earth on the moon is already calculated above (equation-i, iii, v). Net force acting on the moon (R_G) due to combined impact of these two gravitational forces can be calculated using law of vector addition. As the angle between the two forces is 90° so simple trigonometric relationship can be used to calculate the resultant force as below:

ix- Net gravitational force acting on the moon

Gravitational force from the sun on the moon ($G_{s\text{-}m}$) = $4.172x10^{20}$ N

Gravitational force from the earth on the moon ($G_{e\text{-}m}$)

= $1.899x10^{20}$ N (see equation v)

Resultant gravitational force R_G

$$(R_G)^2 = (G_{s\text{-}m})^2 + (G_{e\text{-}m})^2 = (4.172x10^{20})^2 + (1.899x10^{20})^2$$

$$R_G = \sqrt{(4.172x10^{20})^2 + (1.899x10^{20})^2} = 4.584x10^{20}\ N$$

$$\theta = Tan^{-1}\ (4.172x10^{20} \div 1.899x10^{20}) = 65.526°$$

Obviously, the resultant gravitational force (R_G) of $4.584x10^{20}$ N will be acting on the moon at an angle of 65.526° relative to the earth (Fig5.3B). As a result the moon must be moving towards the sun along the direction of resultant force "R_G" and cannot stay with the earth. However, the moon revolves around the earth and acquires different positions with respect to the sun and the earth. Therefore, it is concluded that the moon is not under the influence of gravitational pull from the sun. Concept of double planet system is inappropriate. The moon does not move in pair with the earth. Similar conclusion was drawn by Goulding (1872) who also disagreed with zigzag or looped pathway of the moon around the earth. He postulated that the moon needs to move with velocity much higher than that of the earth for zigzag and looped orbital motion.

Suppose the earth goes to position "e4" and the moon is at position "d" in its orbit (revisit Fig-5.2C). In this situation the earth will be in between the sun and the moon. The forces of gravitation from the sun and the earth on the moon in this situation are highlighted in Fig-5.3C. Gravitational forces from the sun (G_{s-m}) and the earth (G_{e-m}) on the moon will be acting in the same direction. Magnitude of the resultant force (R_G) on the moon is calculated below:

x- Net gravitational force (R_G) on moon when earth is in between the sun and the moon

Gravitational force of the sun on the moon, G_{s-m}

$= [(G. M_{moon}. M_{sun}) \div (R_{sun-moon})^2]$

$= [(6.67x10^{-11} x\ 7.0x10^{22} x\ 2.0x10^{30}) \div (1.504x10^{11})^2] = 4.128x10^{20}$ N

$M_{moon} = 7.0x10^{22}$ Kg,

$R_{sun-moon} = 1.504x10^{8}$ Km or $1.504x10^{11}$ m ($R_{sun-earth} + R_{earth-moon}$)

Gravitational force from the earth on the moon (G_{e-m}) = $1.899x10^{20}$ N

Net gravitational force on the moon $R_G = F_{s-m} + G_{e-m} = 6.027x10^{20}$ N

Net gravitational force (R_G) of $6.027x10^{20}$ N directed towards the sun is applied on the moon when the sun, the earth and the moon are in line. The moon must bump into the earth as a consequence.

Mathematical assessment of double planet system of earth-moon revolving around the sun under the influence of gravity does not seem valid. The moon cannot revolve around the earth if it is simultaneously under the gravitational pull from the earth and the

sun. Laws of physics do not validate the motion of the moon in looped or zigzag orbit. It has to be assumed that the sun exerts gravitational pull on the earth but there is no effect of gravitational force from the sun on the moon. The earth revolves around the sun under the influence of gravitational force but the moon moves along the earth in zigzag orbit independently without the influence of gravitational force from the sun. The moon has to move with variable speed for zigzag fashion of motion around the earth's orbit. Concept of double planet system being unscientific and irrational cannot be approved and substantiated mathematically. The moon revolves around the earth but its revolution cannot be elucidated if the earth is also supposed to orbit the sun. Consequently, notion of orbital motion of the earth is not convincing at all.

5.1.3 Gravitationally bound earth-moon system

Another idea to explain revolution of the moon around the earth that revolves around the sun is mentioned below:

> *"The moon does not simply revolve around the earth instead gravitationally bound single independent system, "the earth-moon system", rotates around a common center of gravity called barycenter (Allen, 2009; Bloomfield, 2001; Hubbard, 2000; Pretka-Ziomeck et al., 2000; Reddy, 2001). The barycenter remains stationary with respect to the earth-moon system and lies about 1700 km below the earth's surface (Enc. Britannica, 2008; Hubbard, 2000). It is the barycenter that moves in an elliptical orbit around the sun rather than the center of mass of the earth alone (Barbeiri, 2006; Montenbruck et al., 2000; Tumalski, 2004). The sun acts on the earth and its moon as one entity with its center at the barycenter".*

Gravitational bound earth-moon system with common center of mass may be visualized by considering a dumbbell with a much larger ball at one end than that at the other end (Davis and Fitzgerald, 2009). An example of dumbbell and earth moon system with common center of gravity (the barycenter) is represented in Fig-5.4. Consider a bigger ball "a" at one end of a rod and smaller ball "b" at the other end as shown in Fig-5.4A. The big ball "a" will wobble around the common center of gravity, the barycenter "c" tracing circle "1" and the smaller ball "b" will appear orbiting the bigger ball in circle "2". The position of ball "b' will not change relative to the ball "a" with rotation of the dumbbell.

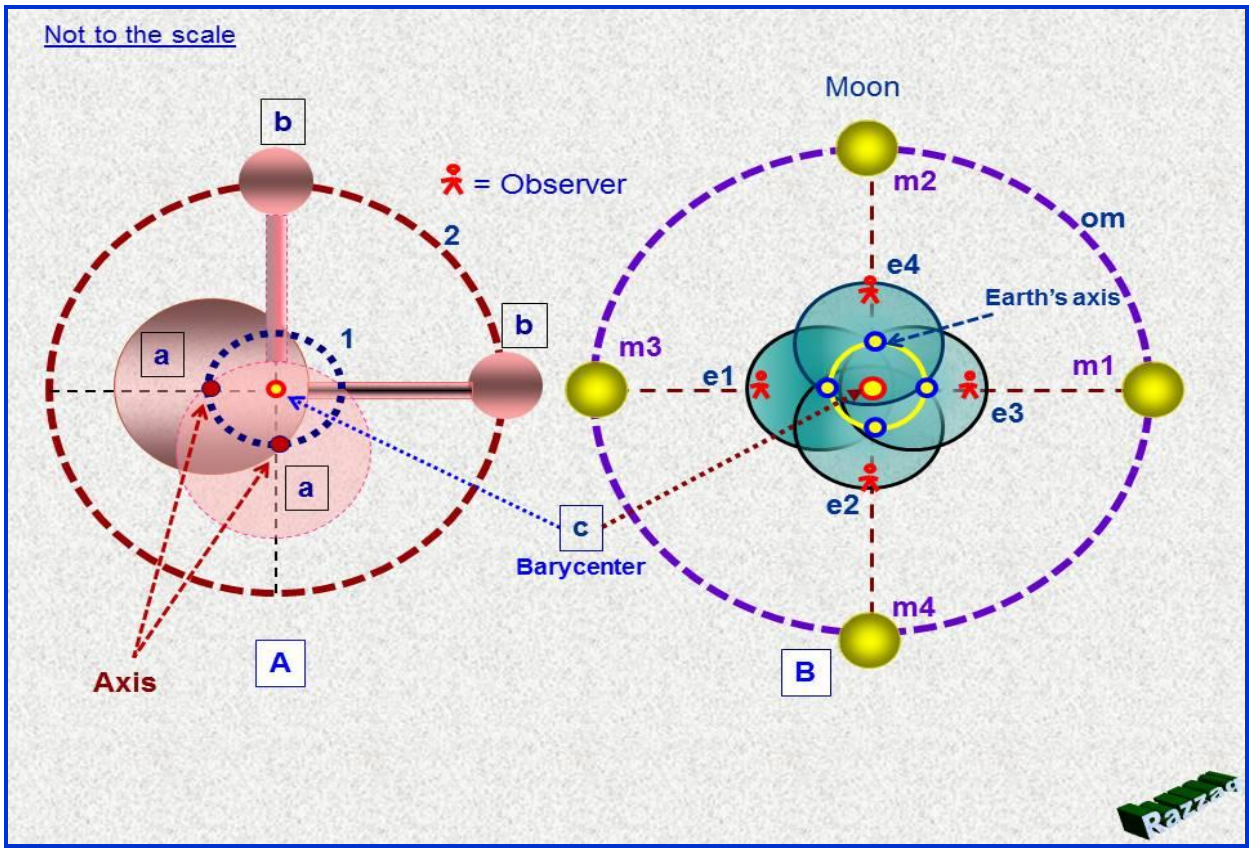

Fig – 5.4: Barycenter, dumbbell and earth-moon system. **A:** Dumbbell with a big ball "**a**" and a small ball "**b**". **c:** Common center of gravity (barycenter). **1:** Rotation circle of big ball "a" around the barycenter. **2:** The circle in which the ball "**b**" moves. **B:** Gravitationally bound Earth-Moon system with common center of gravity. **e1, e2, e3, e4:** Different positions of the earth with rotation of the system. **om:** Circular path of the moon with rotation of the system. **m1, m2, m3, m4:** Different positions of the moon with rotation of the system.

Now visualize the earth-moon system with common center of gravity just like a dumbbell. Suppose the earth is at position "e1" and an observer on the earth is viewing the moon at position "m1" in the orbit "om" (Fig-5.4B). When the earth-moon system will rotate anticlockwise about the barycenter "c" the earth will go to position "e2" and the moon will move to the position "m2". The observer will remain at the same position with respect to the moon. When the earth will go to the position "e3" and "e4" the corresponding positions of the moon will be "m3" and "m4", respectively. As the earth-moon system behaves as a single entity therefore earth's speed of rotation must be same as that of angular motion of the moon relative to the barycenter. So, the observer will remain at the same position relative to the moon. Consequently, if the concept of earth-moon system rotating about the common center of gravity is accurate then the moon should always appear at the same position to the observer on the earth. It should never change its position relative to the observer.

Nonetheless, the moon continuously changes its position relative to the observer on the earth. The observed fact is against the expected consequence of gravitational bound earth-moon system rotating about the common center of gravity. The angular speed of the observer due to axial rotation of the earth is much higher than that of the moon relative to the center of the earth. Thus, barycenter must be changing continuously against the assumption that barycenter remains stationary (Enc. Britannica, 2008; Hubbard, 2000; Love, 2005). Simultaneous rotation of the earth about the axis and wobbling around the stationary barycenter cannot be explained according to the laws of physics. It is beyond imagination. Barycenter has to move if the earth rotates about its axis. Otherwise, it will not be possible to justify axial rotation of the earth and apparent motion of the moon if gravitationally bound earth-moon system rotates around a stationary barycenter. Similarly, if it is assumed that the barycenter revolves around the sun then the part of the earth facing the moon should never change. Therefore, the idea of motion of the moon and wobbling of the earth around the stationary barycenter is invalid and cannot be substantiated logically and scientifically.

5.1.4 Simultaneously independent and interlinked system

The earth revolves around the sun while rotating about its axis. The moon revolves around the earth and force of gravity keeps the moon in its orbit (Friedman, 2013). The moon has to move with the earth orbiting the sun. Several ideas have been suggested to justify revolution of the moon around the earth that moves around the sun. One assumption is that the earth and the moon are independent planets (Akulenko et al., 2005; Bloomfield, 2001). The other consideration is that the earth and the moon are held together by mutual gravitational force (Anonymous, 1992; Reddy, 2001). The moon does not revolve around the sun independently but indirectly it keeps revolving around the sun. These are the postulates to anticipate orbital revolution of the moon around the earth and keeping the moon linked with the earth throughout orbital motion of the earth around the sun. These ideas reveal that:

> ***"The moon while rotating about its axis revolves around the earth under the influence of gravitational force. Thus the earth and the moon should behave as separate independent systems. However the earth orbits the sun while rotating about its axis. Therefore, the moon and the earth should be moving together as one interlinked system around the sun".***

Consequently the earth and the moon should be independent systems when rotation of the earth and orbital revolution of the moon is considered. But they should behave as one interlinked system when the moon moves with the earth during orbital revolution around the sun. Is it possible for a physical system of two bodies to have this kind of dual nature? Let us analyze a system of two bodies and probability of simultaneously independent and interlinked behavior employing the principles of physics.

5.1.5 Independent system of two balls

Consider a big ball “a” in the center of a circular ring and a small ball “b” attached to the ring (Fig-5.5). Let the two balls be independent systems. Suppose the ball “a” is rotating anticlockwise and the ball “b” is sliding on the ring (revolving around the ball “a”) also in anticlockwise direction. Angular speed of rotation of ball “a” (90°/hour) is higher as compared with the angular speed of sliding ball “b” (18°/hour relative to the center of the ring). An observer on ball “a” at position “p” and the ball “b” at position “x” on the ring are on the line passing through the center of the ball “a” (Fig-5.5A). The observer reaches to position “q” in one hour after 90° rotation of the ball “a” but the ball “b” revolves only 18° in one hour and reaches to position “y”. The ball “b” will appear moving clockwise (receding) with respect to the observer on ball “a” because of higher speed of rotation of ball “a”. However, the point at which the observer and the ball “b” align again will shift anticlockwise. Relative positions of the observer and ball “a” will be same again after 5 hours as calculated below:

i- Rotation of ball “a” in 5 hours
Angular speed of ball “a” = 90°/hour
Rotation of ball “a” in 5 hours = 90 x 5 = 450° or one complete rotation + 90°
ii- Revolution of ball “b” in 5 hours = 18 x 5 = 90°
Revolution speed of ball “b” relative to the center of the ring = 18°/hour

Therefore, the observer on ball “a” and the ball “b” will align again after 5 hours. At this moment the ball “b” will be at position “z” after revolving 90° and the observer will be at position “r” after rotation of 450° (one complete rotation + 90°) of ball “a” (Fig-5.5B). So, the ball “b” revolving anticlockwise apparently looks moving clockwise to the observer on ball “a” that is rotating anticlockwise with angular speed greater than that of the ball “b”. However, the position at which both the observer and the ball “b” align again shifts anticlockwise.

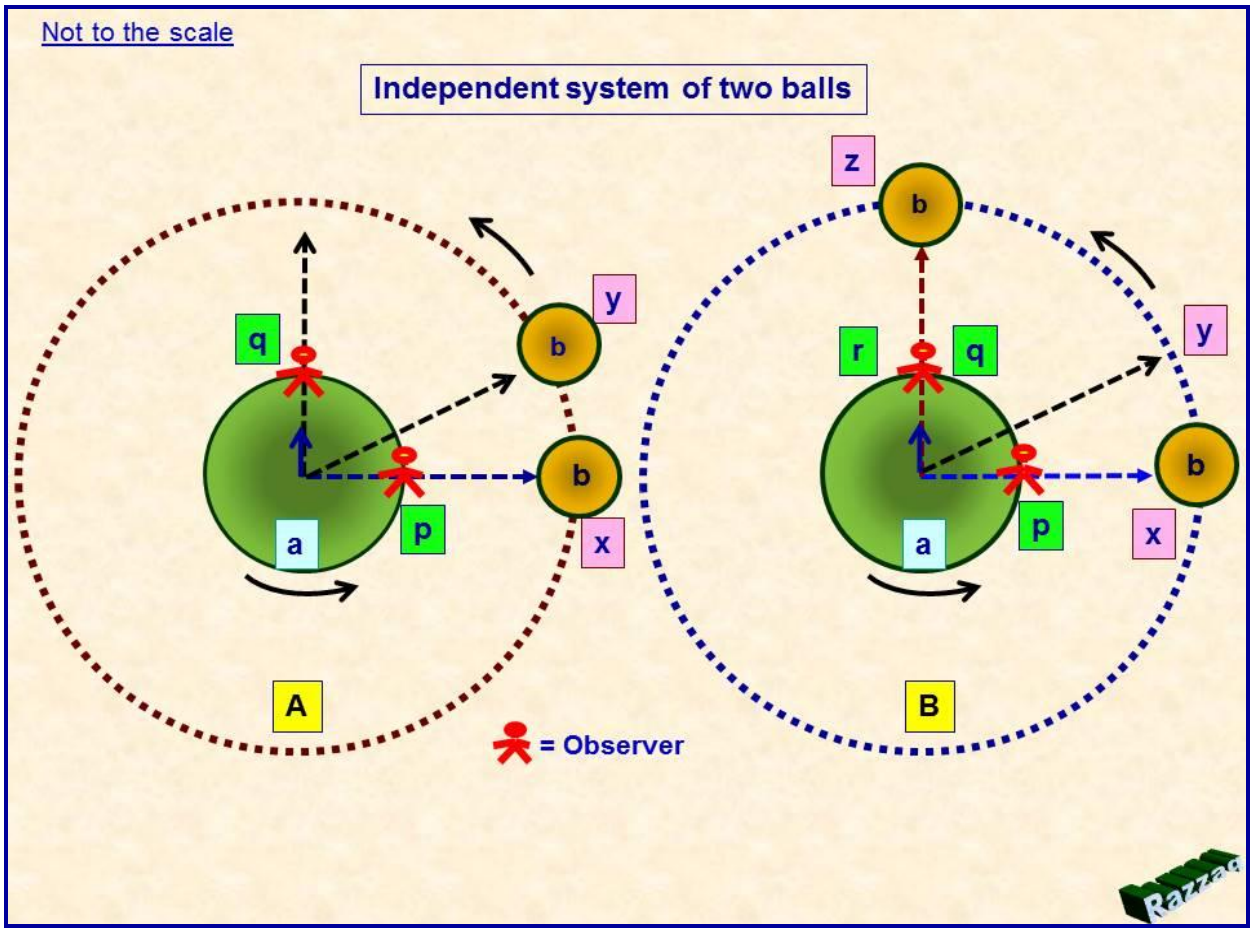

Fig – 5.5: Independent system of two balls. **A:** Independent rotation/revolution of two balls. **a:** A big ball at the center with anticlockwise rotation. **b:** A small ball revolving anticlockwise around the ball "**a**". **p:** Initial position of the observer on ball "**a**". **q:** Position of the observer with 90° rotation of ball "**a**" in one hour. **x:** Initial position of the ball "b". **y:** Position of ball "**b**" with 18° revolution. **B:** Observer and the small ball after 5 hours. **r:** Position of the observer on ball "**a**" after 5 hours. **z:** Position of ball "**b**" after 5 hours.

Hence, in a system of two independent bodies if one body revolves anticlockwise with a slow speed around a second body rotating anticlockwise with higher angular speed then it can be inferred that:

a) The revolving body will apparently move clockwise (receding motion) to the observer on the rotating body.

b) The point at which the observer on rotating body will align again with the revolving body will shift anticlockwise every next turn.

This example of two balls is very similar to revolution of the moon around the earth rotating about its axis. Rotation period of the earth is about 23.93446959 hours/360° (Lewis, 2003) whereas revolution period of the moon relative to the stars is

27.32166155 days/360° (IERS, 2014). Relative change in position of observer on the earth and that of the moon after one hour is calculated below:

iii- Rotation of the earth in one hour
Rotation period of the earth = 23.93446959 hours/360°
Rotation of the earth in one hour =
{(360 ÷ 23.93446959) x 1)} = 15.0411°
iv- Revolution of the moon in one hour
Revolution period of the moon =
27.32166053 days or 655.71985272 hours/360°
Revolution in one hour = {(360 ÷ (655.71985272) x 1)} = 0.5490°

The moon will revolve only 0.5490° in one hour whereas observer will have rotated 15.0411° with the earth. So the observer will feel that the moon has moved clockwise. The moon revolves around the earth anticlockwise (Seeds and Backman, 2015) but apparently looks moving clockwise from east to west due to anticlockwise rotation of the earth with angular speed greater than that of the moon. Every day the point of alignment of the observer and the moon shifts anticlockwise. This kind of motion is possible only if the earth and the moon are independent systems. Therefore, it is concluded that the earth and the moon are two independent systems. The earth rotates anticlockwise and the moon revolves around the earth also in anticlockwise direction as an independent system under the influence of gravity.

5.1.6 Interlinked system of two balls

Let us now consider an interlinked system of two balls. Suppose a big ball “a” fixed at the center of a circular board, an observer sitting on the big ball at position “m”, ring “r” attached with the board along its periphery and a small ball “b” attached with the ring is at point “x” as portrayed in Fig5.6A. The system is rotating anticlockwise at the rate of 90°/hour with respect to the center of the ball “a”. As the system is interlinked so all the components including big ball “a”, the observer, the board and the ring with small ball “b” move with same angular speed relative to the center of the big ball. There will be no change in position of the ball “b” relative to the observer on ball “a” after one hour anticlockwise rotation of the system (Fig-5.6B).

Suppose that the ball “b” is also sliding anticlockwise on the ring with angular speed of 15°/hour within this interlinked system and the system is also moving ahead. Initial position of the observer on ball “a” relative to the ball “b” and the situation after one hour

is represented in Fig-5.6C. The observer on ball “a” will notice that the ball “b” has revolved 15° anticlockwise in one hour. However, a person outside the system will see that the observer has rotated 90° within the system from “m” to “n” whereas the ball “b” has rotated 105° (90° + 15°) from its initial position relative to the center of the system and will be at position “y” on the ring as the system moves forward from position “1” to “2” in one hour. The apparent motion of the ball “b” to the observer in the system will be anticlockwise.

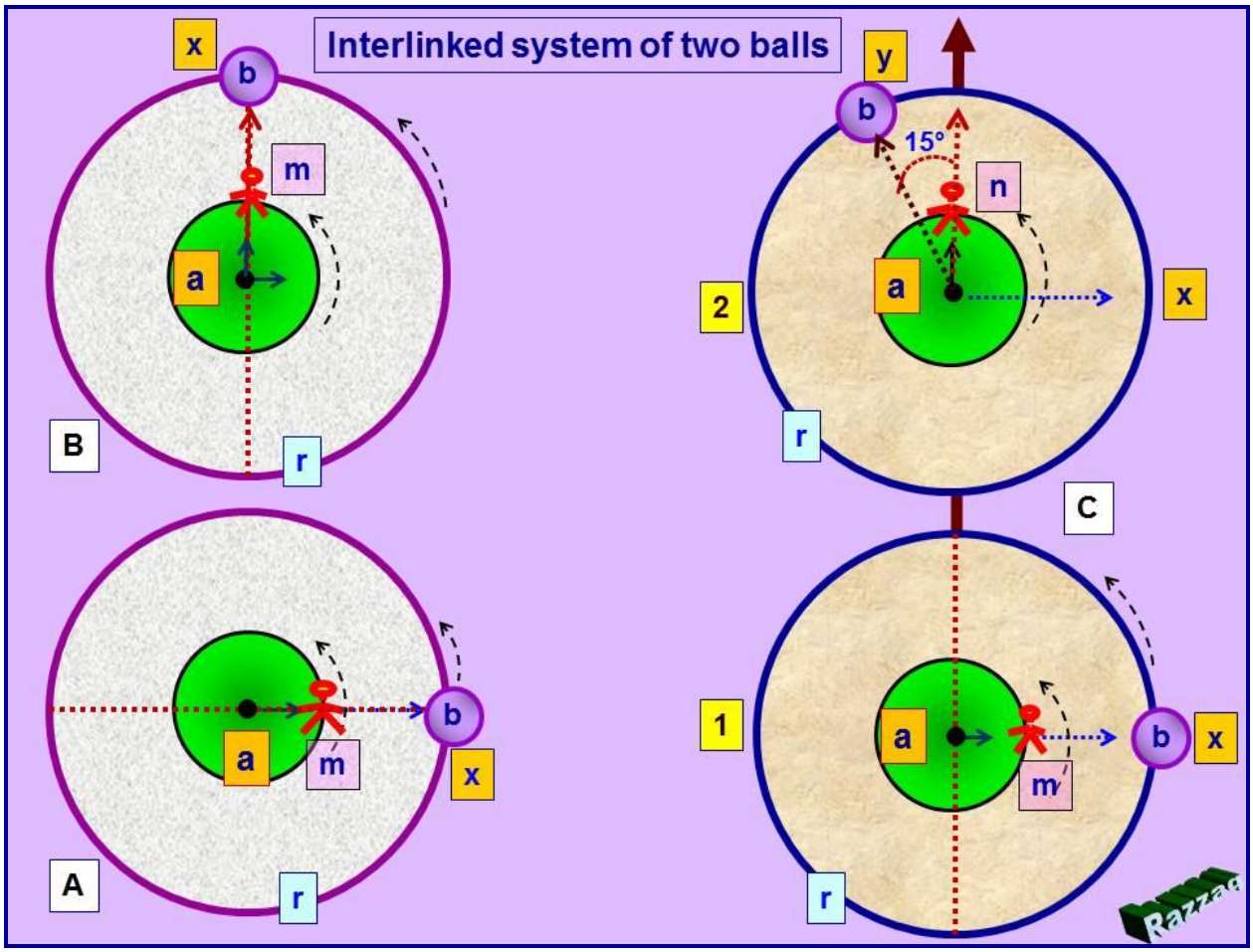

Fig – 5.6: Interlinked system of two balls rotating anticlockwise and moving forward. **A:** Initial position of the system. **a:** Big ball fixed in the center of the board. **m:** Position of the observer on ball “a”. **r:** A ring attached at the periphery of the board **b:** A small ball attached to the ring, **x:** Initial position of small ball. **B:** Situation after one hour with rotation of the system and no forward motion. **C:** Initial (**“1”**) and situation after one hour (**“2”**) if the ball “**b**” moves anticlockwise within the system moving forward. **n:** Position of the observer relative to the ball “a” with 90° rotation of the system. **y:** Position of ball “a” with 15° angular motion in one hour relative to the center of the board.

Thus, in an interlinked system of two spherical bodies moving forward and rotating anticlockwise if a small body is also moving anticlockwise along the periphery then the apparent motion of the small body to the observer inside the system will be

anticlockwise. It will appear moving clockwise only if it moves clockwise along the boundary of the system. The moon, however, revolves anticlockwise around the earth but appears moving clockwise due to higher rotation speed of the earth compared with the speed of the moon in the orbit. Thus the supposition that the earth and the moon form a single interlinked system bound together by gravity (Hecht, 2003) does not seem rational and mathematically valid.

Consider another example. Just imagine that an observer is standing on the North Pole of the earth. An object is flying anticlockwise with a speed of about 2 km/hour in a circle of radius 5 km around the pole. The observer will clearly notice that the object is moving anticlockwise. The earth rotates anticlockwise about its axis. The observer is also rotating anticlockwise with the earth. If the flying object appears to move anticlockwise then it must be a part of the earth system moving corresponding to rotation of the earth otherwise the object must appear receding clockwise due to higher speed of rotation of the earth. Therefore, all the components must be linked together i.e. the earth, the observer and the flying object constitute a single system or one unit. Flying object does not appear to recede clockwise due to rotation of the earth because it belongs to the same system. Its anticlockwise motion within the system relative to the observer is noticeable.

The moon does not apparently move anticlockwise to an observer on the earth so the system is not interlinked as was perceived by Akulenko et al. (2005) and Bloomfield (2001). Moon appears to move from east to west (clockwise) due to rotation of the earth. Point at which the observer on the earth and the moon align again shifts anticlockwise every next day. Therefore, it must be a system of two independent bodies as explained above in independent system of two balls. The moon revolves around the earth due to gravitational force (Friedman, 2013) but is not linked with the earth. This will justify the apparent clockwise motion and anticlockwise orbital revolution of the moon. Nevertheless, it will not be possible to explain motion of the moon in company of the earth orbiting the sun if the system is considered independent. The orbital revolution of the earth will become questionable. We have to assume that the earth-moon system behaves as a single unit or interlinked system to justify the orbital revolution of the moon accompanied with the earth in the orbit. As a result, the earth and the moon should behave as independent systems for orbital revolution of the moon around the earth, and

interlinked single unit to validate orbital revolution of the earth accompanied with the moon. However, this dual nature of a physical system of two objects is not possible scientifically. No such example may be quoted from the world of physics. Hence, it will not be illogical to infer that orbital revolution of the moon around the earth cannot be justified if the earth is assumed orbiting the sun. Thereby, the notion of orbital motion of the earth scientifically unsubstantiated becomes questionable.

5.2 Sidereal month and earth's revolution

Sidereal month is the time the moon takes to complete one revolution around the earth with respect to the fixed stars. Revolution period of the moon with respect to the stars (sidereal month) is almost 27.32166155 days or 2360591.55792 seconds (IERS, 2014; The Columbia E Enc., 2007; Whipple, 2007). The earth also revolves in the orbit around the sun while rotating about its axis. The stars are assumed stationary according to the postulates of heliocentric theory. Therefore, the moon must be at the same position relative to the reference star after completing revolution each time.

Suppose the moon at position "m1" is in line with a distant star indicated by arrow "s1" when the earth is at position "e1" in the orbit (Fig-5.7).

The moon completes one revolution with respect to the stars in 27.32166155 days. Revolution of the earth in this time (sidereal month) is calculated below:

i- Revolution of the earth in sidereal month

Revolution period of the earth = 31556925.25 s
Length of sidereal month = 27.32166155 days or 2360591.55792 s
Revolution of the earth in sidereal month =
{(360 ÷ 31556925.25) x 2360591.55792} = 26.929523523563°

Therefore, when the moon completes one orbital revolution the earth will be at position "e2" after revolving 26.92952188° in orbit. The moon will be at position "m2" on arrow "s2" after revolving 360° relative to the center of the earth in this time. The reference star should again be in line with the moon at this position. Therefore, it has been assumed (Denecke and Carr, 2006; Millham, 2012; Whipple, 2007) that as the stars are far away so the earth and the moon on arrow "s2" parallel to "s1" will be in line with the same star (revisit Fig-5.7). Similar assumption is also made by the astronomers to justify continuous pointing of earth's axis towards the pole star throughout the orbital revolution (Gates, 2003; Plait, 2002) and to justify sidereal day.

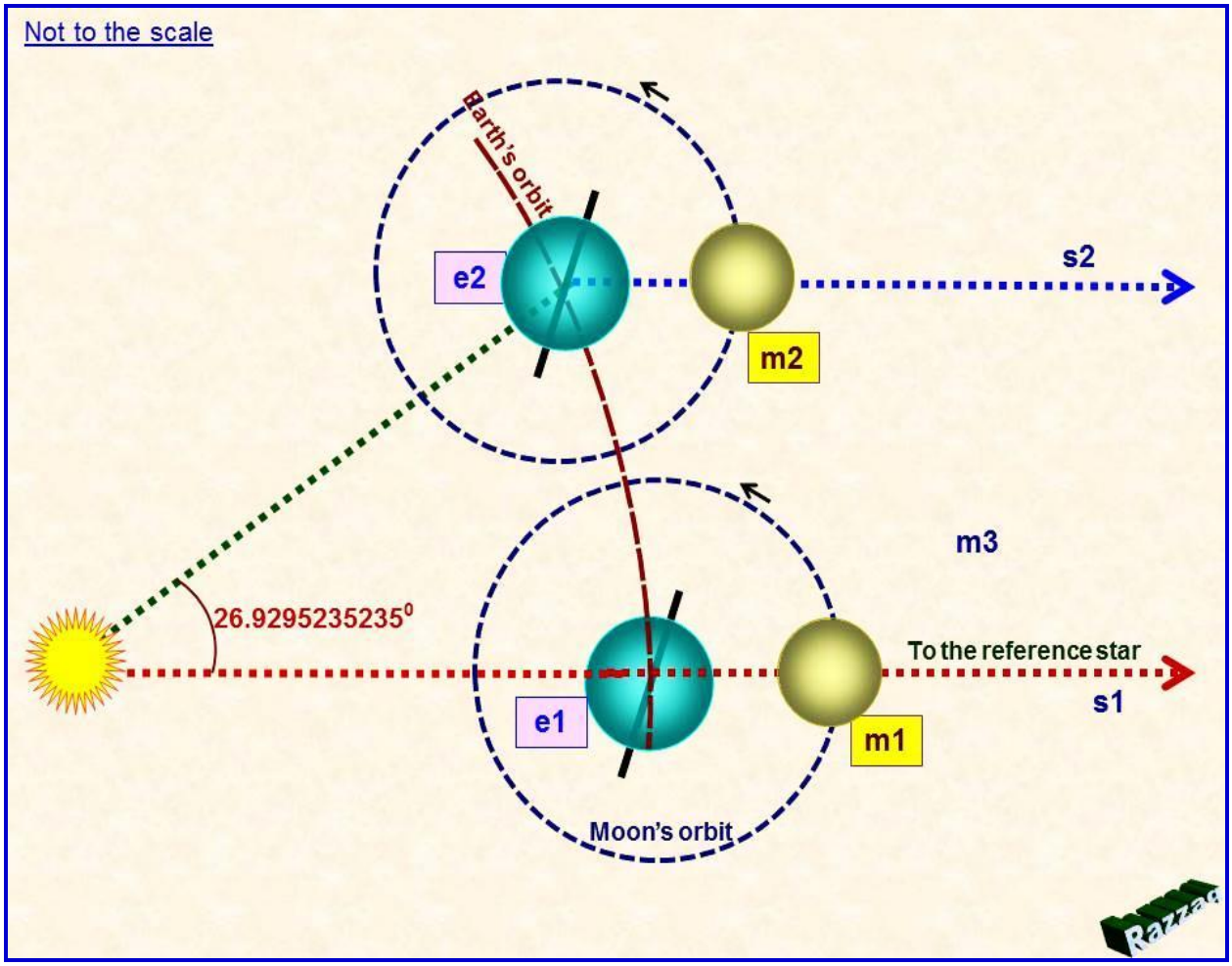

Fig – 5.7: Revolution of the moon around the earth and sidereal month. **e1:** Initial position of the earth in orbit. **e2:** Position of the earth in orbit after sidereal month. **m1:** Initial position of the moon in orbit. **m2:** Position of the moon after sidereal month. **s1:** Arrow pointing to the reference star. **s2:** Arrow parallel to "**s1".**

Therefore, it can be hypothesized that:

> *"If the moon in its orbit and the earth remain on lines parallel to original earth-moon-star line, the moon after revolving 360° relative to the center of the earth in sidereal month will be in line with the reference star throughout the orbital motion of the earth".*

Earth's sidereal period of revolution is 1224.51 seconds (about 20 minutes) longer than the tropical period and this difference is attributed to the precession of equinoxes (Capderou, 2005). The earth will not be at the same position with respect to the reference star after tropical year (365.24219904 days). The earth needs to revolve 0.01396009° more to align with the reference star and to complete 360° revolution in 365.25636296 days (sidereal period of revolution) as calculated below:

ii- Additional revolution needed to complete 360° after tropical year

Period for 360° revolution of the earth = 365.25636296 days

Revolution in 365.24219904 =

[(360 ÷ 365.25636296) x 365.24219904] = 359.98603991°

Additional revolution needed to complete 360° =

(360 - 359.98603991) = 0.01396009°

This implies that if the earth revolves 0.01396009° with respect to the center of the sun then it will not remain at the same position relative to the reference star. Suppose the earth is at position "x1" in the orbit on arrow "p1" pointing to the reference star (Fig-5.8). Arrows "p2", "p3", "p4" and "p5" are parallel to the arrow "p1". Let the earth go to position "x2" on arrow "p2" after revolving 0.01396009° in the orbit. As a result, the earth and the reference star will not be aligned although the arrow "p2" is parallel to "p1". Perpendicular displacement "d1" of the earth from "x1" to "x2" with 0.01396009° revolution relative to the sun is calculated below:

iii- Perpendicular displacement (d1) from "x1" to "x2"

Sinθ = (perpendicular ÷ hypotenuse)

Perpendicular (d1) = ?, θ = 0.01396009°

Hypotenuse (distance of the earth from the sun) = 1.50×10^8km

d1 = Sin0.01396009° x 1.5×10^8 = 3.6547×10^4 km

Thus the perpendicular displacement of the earth with 0.01396009° revolution relative to the sun will be 3.6547×10^4 km. Now consider that the moon is at position "m1" and goes to position "m2" on arrow "p2" while revolving in the orbit. The perpendicular displacement ("d1") of the moon from its original position "m1" will be 3.6547×10^4 km. Revolution of the moon required for being on arrow "p2" and its angular displacement with respect to the sun can be calculated as follows:

iv- Revolution of the moon from "m1" to "m2" (θm)

Perpendicular displacement from "p1" to "p2" = 3.6547×10^4 km

Hypotenuse (distance of the moon from the earth) = 3.84×10^5 km

Sinθm = (perpendicular ÷ hypotenuse)

θm = $Sin^{-1}(3.6547 \times 10^4 \div 3.84 \times 10^5) = 5.461362235°$

v- Angular displacement of the moon relative to the sun (θ1)

Perpendicular displacement from "p1" to "p2" = 3.6547×10^4 km

Hypotenuse (distance between the sun and the moon)

= 1.50384×10^8km

θ1 = $Sin^{-1}(3.6547 \times 10^4 / 1.50384 \times 10^8) = 0.01392428°$

Therefore, it becomes obvious that angular displacement of the moon with respect to the sun will be 0.01392428° when the moon revolves 5.461362235° in its orbit from

"m1" to "m2" and goes to arrow "p2". If the earth goes to the position "x2" from "x1" on arrow "p2" with revolution of 0.01396009° with respect to the sun the reference star will not be aligned with the earth although the arrow "p2" is parallel to "p1" pointing to the reference star. The moon at position "m2" on arrow "p2" parallel to "p1" after revolving 5.461362235° around the earth or 0.01392428° with respect to the sun will not be aligned with the reference star as well. Let the earth remain at the same position "x1" but the moon revolves and reaches to position "m2" on arrow "p2" after perpendicular displacement of 3.6547×10^4 km. Certainly, the moon will not be in line with the sun, the earth and the star.

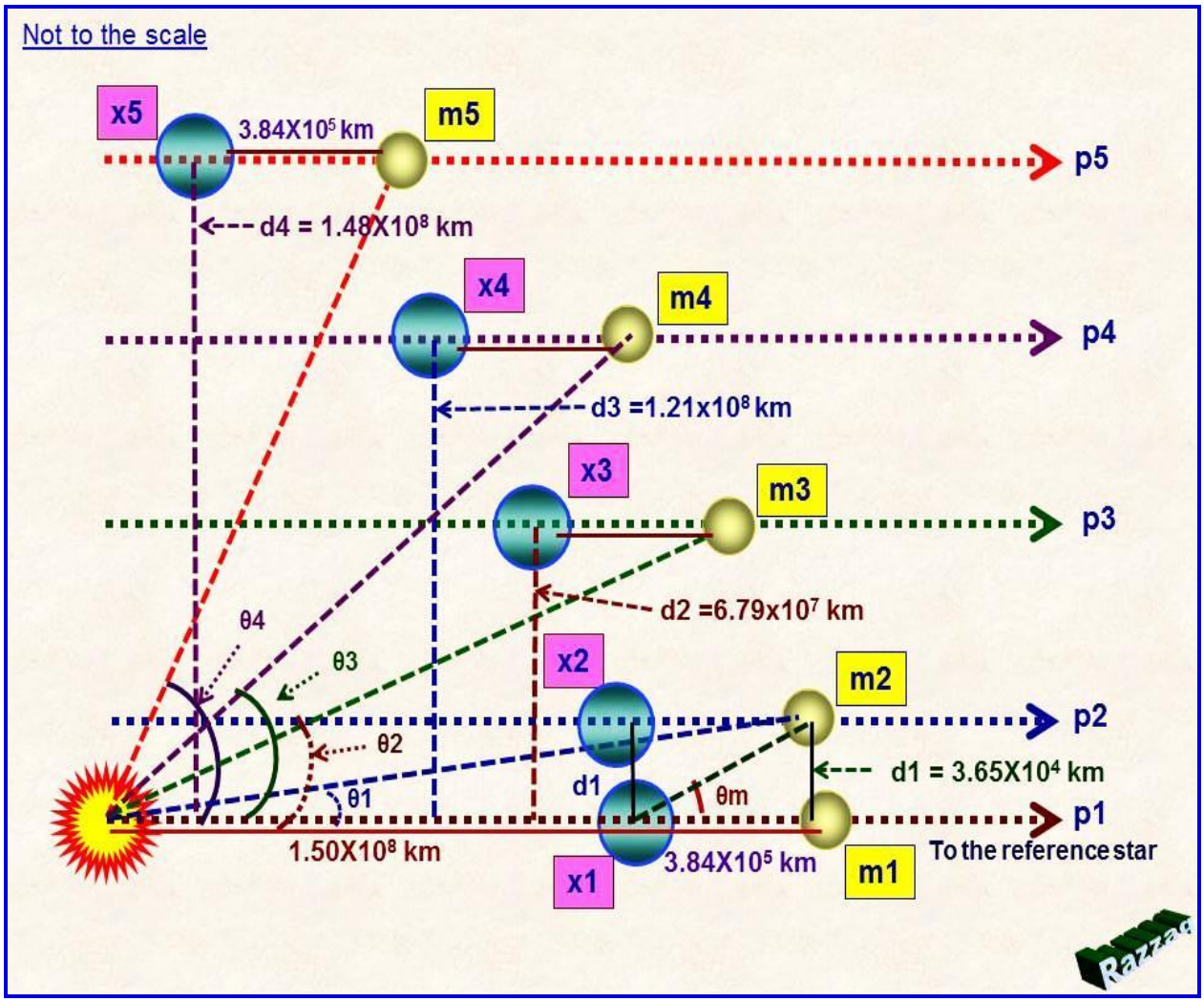

Fig – 5.8: Revolution of the moon, the earth and parallel lines. **x1:** Initial position of the earth. **m1:** Initial position of the moon. **p1:** Arrow passing through the sun, the earth and the moon pointing to the reference star. **x2:** Position of the earth after revolving 0.01396009° relative to the sun. **m2:** Position of the moon after revolving **θm** (5.461362235°) relative to the earth at "x1". **p2, p3, p4, p5:** Arrows parallel to "**p1**". **x3, x4, x5** and **m3, m4, m5:** Positions of the earth and the moon after 1st, 2nd and 3rd sidereal month, respectively. **d1, d2, d3, d4:** Represent perpendicular distance from "**p1**". **θ1, θ2, θ3, θ4:** Angular displacement of the moon with respect to the sun.

The moon while orbiting the earth simultaneously moves in orbit of the earth. So the moon will be at position “m3”, “m4” “m5” on arrows “p3”, “p4” and “p5” after 1st, 2nd and 3rd sidereal month, respectively (revisit Fig-5.8). The earth will be at position “x3”, “x4” “x5” accordingly.

Perpendicular displacement of the moon from arrow “p1” and angular displacement with respect to the sun at these positions can be calculated as below:

vi- Revolution of the earth in 1, 2 and 3 sidereal months

Tropical revolution period of the earth = 365.24219904 days

Revolution in one sidereal month (θ2)

= {(360 ÷ 365.24219904) x 27.32166155} = 26.92952289°

Revolution in two sidereal month (θ3) = 53.85904577°

Revolution in three sidereal months (θ4) = 80.78856866°

vii- Perpendicular displacement of the earth (and the moon also) after 1, 2 and 3 sidereal months from initial position (p1)

Sinθ = (perpendicular ÷ hypotenuse)

$d2 = \sin\theta2 \times 1.50\times10^{8} = 6.79\times10^{7}$ km

$d3 = \sin\theta3 \times 1.50\times10^{8} = 1.21\times 10^{8}$ km

$d4 = \sin\theta4 \times 1.50\times10^{8} = 1.48 \times 10^{8}$ km

viii- Angular displacement of the moon relative to the sun

θ = Sin-1(perpendicular / hypotenuse)

Perpendicular = displacement from “p1”

Hypotenuse = distance between the sun and the moon)

$\theta2 = \text{Sin-1}(6.79\times10^{7} / 1.50384\times10^{8}) = 26.8406°$

$\theta3 = \text{Sin-1}(1.21\times10^{8} / 1.50384\times10^{8}) = 53.5723°$

$\theta3 = \text{Sin-1}(1.48\times10^{8} / 1.50384\times10^{8}) = 79.7844°$

The moon will be at positions “m3”, “m4” and “m5” on parallel arrows “p3”, “p4” and “p5” after 1st, 2nd and 3rd sidereal month, respectively. The earth and the moon with 0.01396009° and 0.01392428° angular displacement relative to the sun, respectively and $3.65\text{X}10^{4}$ km perpendicular displacement from “p1” cannot be aligned with the reference star. How the moon with 26.92952289°, 53.85904577° and 80.78856866° angular displacement with respect to the sun at “p2”, “p3” and “p4” with $6.79\text{x}10^{7}$, $1.21\text{x}\ 10^{8}$ and $1.48\text{x}10^{8}$ km displacement from its initial position, respectively may be at the same position with respect to the reference star. If the earth at “p2” is not aligned with the reference star then the moon and the earth on arrows “p3”, “p4” and “p5” will not be aligned with the reference star as well. Definitely this is not possible geometrically and logically. The moon cannot be in line with the reference star if the earth also moves in the orbit. Consequently the above hypothesis is not accepted. The moon although

remains on parallel lines cannot come to the same position with respect to the reference star after revolving 360° relative to the center of the earth if the earth also moves in the orbit. Hence the assumption of parallel moon-star lines for appearing the star at the same position (Denecke and Carr, 2006; Millham, 2012; Whipple, 2007) is not rational and scientific. Actually the moon while revolving around the earth aligns again with the reference star exactly after sidereal month. This is possible only if the moon and the earth do not move around the sun. Therefore, it is inferred that the orbital revolution of the earth as perceived in heliocentric model is not a scientifically valid concept.

5.3 Artificial satellites and earth's orbital revolution

Artificial satellites are put in orbit at a certain altitude with a specific horizontal speed. At this speed forward momentum will balance the force of gravity from the earth so the satellite will circle around the earth with uniform speed. The satellite will fall on the earth if momentum is less and leave the gravitational pull if momentum is more. To put a satellite in the orbit around the earth at certain altitude (R) the satellite is given a particular orbital speed (V) that can provide necessary momentum to balance the gravitational pull from the earth. Altitude and orbital speed have to be decided so that the satellite can orbit the earth with desired period (Cutnell and Johnson, 2013; Moore, 2014). Following formulas can help calculate these components:

V (orbital speed) = $\sqrt{(G.M_{central}) / R}$
T (orbital period) = $[(4 \bullet \pi^2 \bullet R^3) / (G.M_{central})]$
Where G = gravitational constant ($6.67x10^{-11}$ Nm^2Kg^{-2})
$M_{central}$ = mass of the earth ($5.972x10^{24}$Kg)
R = distance of the satellite from the earth (altitude)

A geostationary or geosynchronous satellite (GSS) is one whose orbital period is equal to sidereal day (Bertotti and Farinella 1990; Roddy, 2006) i.e. 23.93446958 hours. As earth's rotation period and orbital period of satellite are same so the geosynchronous satellite remains over the same point of the earth. If a satellite is put at an altitude of $3.6x10^4$ km and propelled with horizontal velocity of $3.335x10^3$ m/s in anticlockwise direction in orbit around the earth then it will behave as a geosynchronous satellite.

Suppose that the earth rotates but does not orbit around the sun. A geosynchronous satellite (GSS) in the orbit at "s1" and an observer at "o1" are in line with the center of the earth (Fig-5.9). As revolution period of GSS is equivalent to rotation period of the

earth, so the angular displacement of the observer and GSS relative to the center of the earth will be same. The satellite with 45° anticlockwise revolution will go to position “s2”. The observer with corresponding rotation of the earth goes to “o2” and will be in line with GSS. Positions of the satellite at “s3”, “s4” and “s5” and positions of the observer at “o3”, o4” and “o5” with 90°, 180° and 270° rotation of the earth and revolution of the satellite, respectively will match. So the satellite will be at the same position with respect to the observer as shown in Fig-5.9.

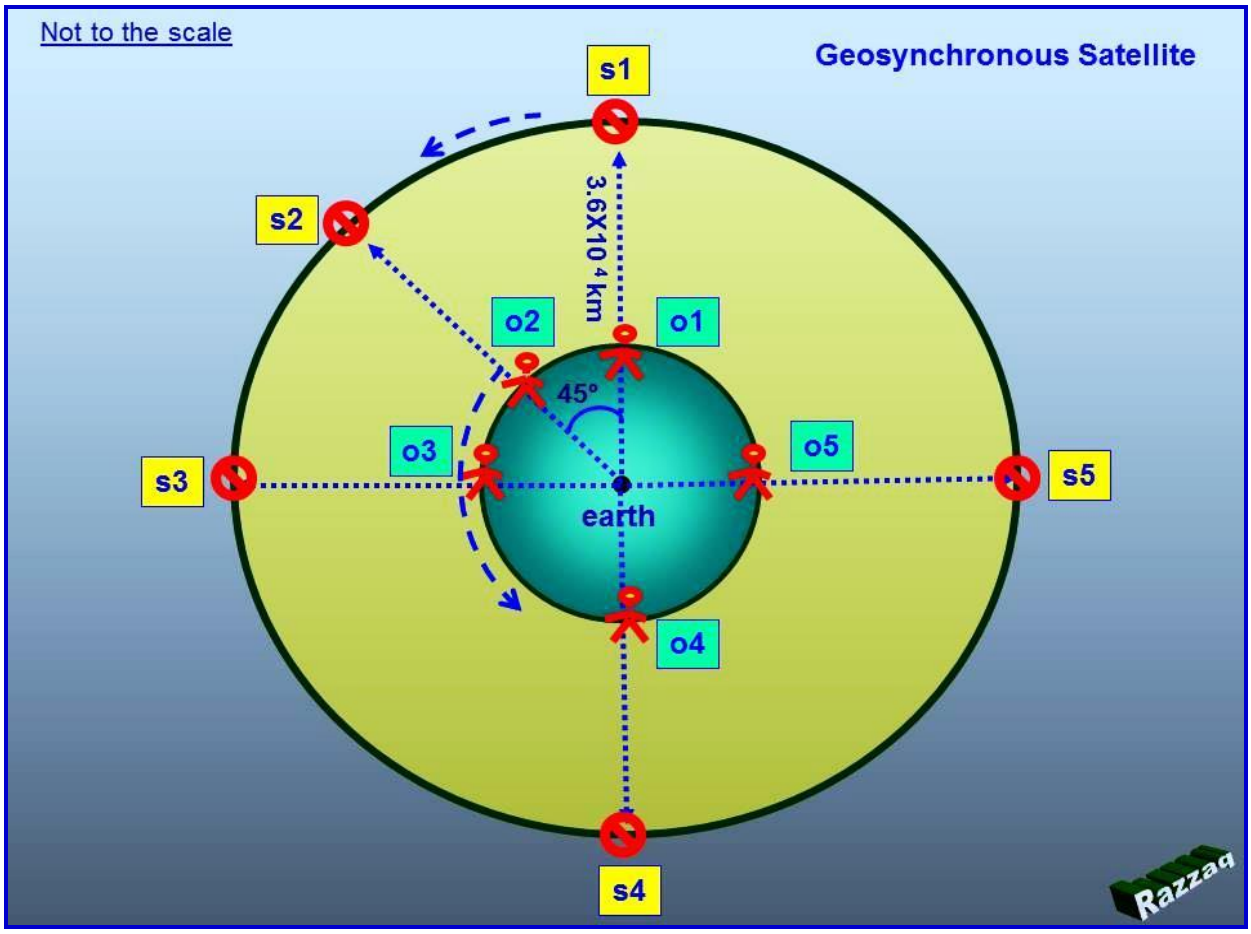

Fig – 5.9: Geosynchronous satellite and the earth as independent systems. **o1:** Initial position of observer on the earth. **o2, o3, o4, o5:** Positions of observer after 45°, 90°, 180° and 270° rotation of the earth, respectively. **s2, s3, s4, s5:** Positions of the satellite after 45°, 90°, 180° and 270° revolution of the satellite, respectively.

The earth is assumed revolving in the orbit simultaneously with axial rotation. Suppose the GSS is at position “a” in the orbit around the earth at an altitude of 3.60×10^4 km and the earth is at position “w” in the orbit (Fig-5.10A). At these positions the direction of orbital revolution of the satellite and that of the earth in the orbit will be in opposite directions. After 90° anticlockwise revolution (in about 6 hours) when the satellite will be

crossing the earth's orbit at point "b" the earth would have moved a distance of $6.48x10^5$ km [(earth's orbital speed x time) = [(30 km/s) x (6 x 3600)] from "w" to "x" in the opposite direction. However, GSS is supposed to be at a distance of $3.60x10^4$ km from the center of the earth.

Similarly, if the initial position of the satellite is "c" (Fig-5.10B) then after 90° orbital revolution, the satellite is supposed to be at "d" in earth's orbit $3.60x10^4$ km ahead of the earth after about six hours. The earth will have moved a distance of $6.48x10^5$ km from "y" to "z" in this time leaving behind the satellite. If the satellite is still at the same position and same altitude from the earth orbiting the sun then there will be no doubt to believe that the satellite and the earth are moving together as a single interlinked system (the earth system).

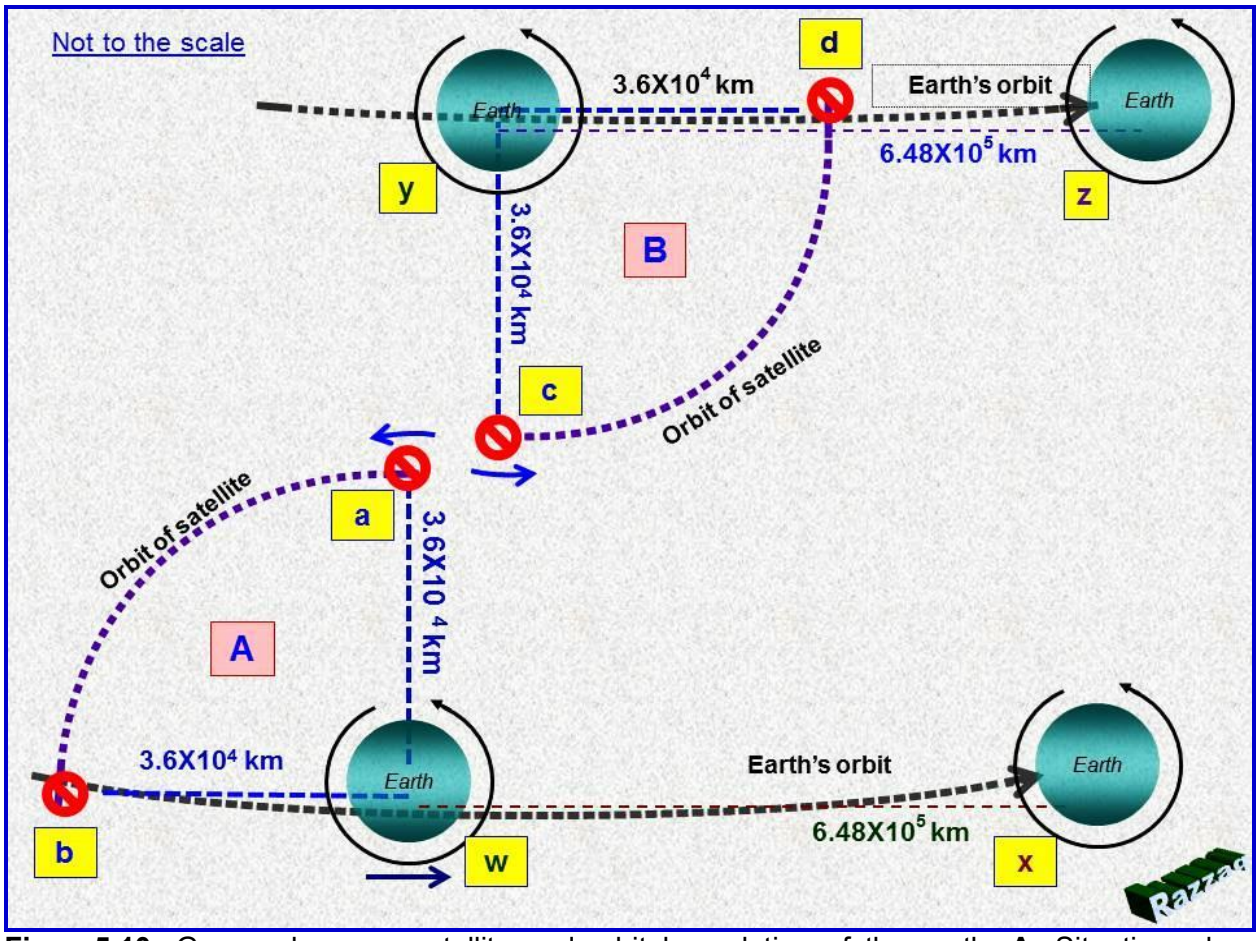

Fig – 5.10: Geosynchronous satellite and orbital revolution of the earth. **A:** Situation when motions of the satellite and the earth are in opposite directions. **a:** Initial position of the satellite. **b:** Position of the satellite after 90° orbital revolution (in about six hours). **w:** Initial position of the earth in the orbit. **x:** Position of the earth after about six hours. **B:** Situation when the earth and the satellite are moving in same direction in their orbits. **c:** Initial position of the satellite. d: Position of the satellite after 90° orbital revolution. **y:** Initial position of the earth. **z:** Position of the earth in orbit after about six hours.

If the earth and the satellite make a single interlinked system then it can be theorized that:

> *"All components of the earth system must be moving corresponding to orbital revolution and axial rotation of the earth. The satellite moving with certain velocity around the earth in the system must remain at the same position (stationary) to an observer on the earth"*.

Suppose an observer at position "o1" on the earth is facing a GSS at point "s1" as represented in Fig-5.11. The observer and the satellite being the components of the earth system must be moving with angular speed corresponding to the rotation of the earth about its axis as well as revolution around the sun.

The observer will reach to position "o2" after 90° rotation of the earth. But the satellite is also revolving around the earth with equivalent speed within the system in addition to its motion with rotation of the system. Therefore the GSS, due to its 90° anticlockwise revolution within the earth system must be at position "s2". The observer on the earth will notice anticlockwise displacement in position of the satellite. The satellite will not remain at the same position relative to the observer on the earth or the satellite will not be a stationary satellite. Consequently, the above hypothesis is refuted. The satellite will not be a geosynchronous if it moves with any speed within the system. It will not look stationary to the observer on the earth. The satellite, being the component the earth system, can appear stationary to the observer only if it is motionless in the system as already explained in interlinked system of two balls (section 5.1.6).

However, GSS revolving with speed equivalent to rotation of the earth looks stationary to the observer on the earth. Therefore, the earth and the satellite must be separate independent systems and not a single interlinked system. If not a part of the earth system, how does the GSS remain linked with the earth throughout its orbital revolution? There is no answer to this question. Revolution of the earth is never considered while calculating orbital components of the satellite (Cutnell and Johnson, 2014). Hence, either the GSS should not remain with the earth or the earth does not move in the orbit. Nonetheless, artificial satellites are put in the orbit with certain horizontal velocity to behave as GSS thereby negating the idea of orbital revolution of the earth.

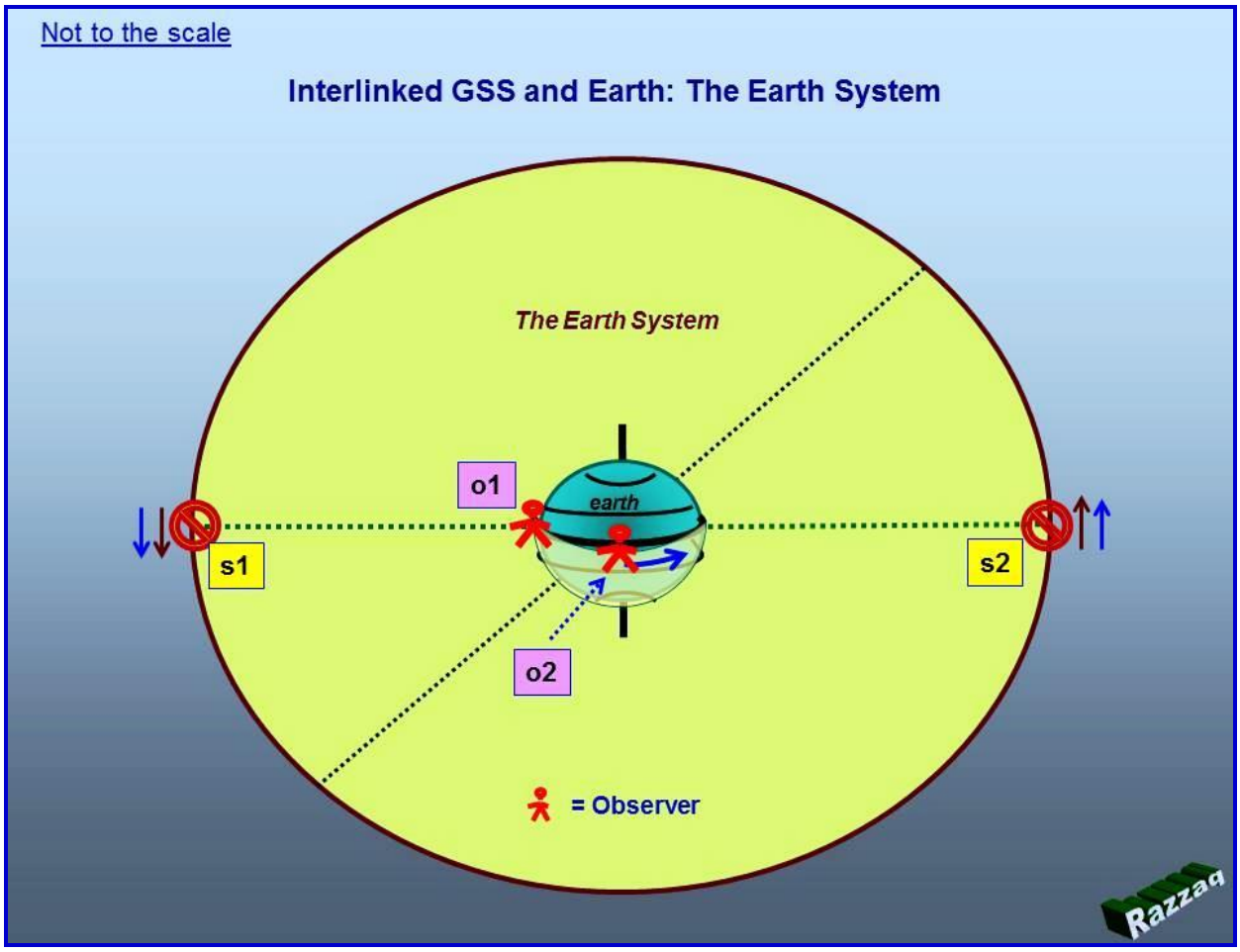

Fig – 5.11: Interlinked geosynchronous satellite and the earth; the earth system. **o1:** Initial position of observer on the earth. **o2:** Position of the observer with 90° rotation of the earth. **s1:** Initial position of the satellite. **s2:** Position of the satellite after 90° revolution in the orbit and 90° rotation of the system.

5.4 Conclusion

Orbital revolution of the moon cannot be justified if the earth is supposed orbiting the sun. Sidereal month cannot be substantiated logically and mathematically if the earth revolves in the orbit. Revolution of artificial satellites around the earth rotating about its axis can be well explained and rationalized according to the principles of gravitation only if the earth does not revolved in the orbit. Orbital revolution of the earth is never considered while deciding altitude, orbital speed and period of artificial satellites. Consequently, revolution of the earth around the sun becomes suspicious without any scientific validity. Therefore, orbital revolution of the earth around the sun under the influence of gravity as perceived in heliocentric model is an invalid supposition and not a scientific reality. Consequently, idea of orbital revolution of the earth is refuted.

CHAPTER 6

6 CONCLUSIVE SUMMARY OF CHAPTER 2 – 5

Heliocentric model places the sun in the center of celestial sphere and the earth is assumed revolving around the sun with tilted axis. Several assumptions have been made to justify the observed phenomena. Heliocentric model with its assumptions was subjected to critical assessment. Conclusive summary based on mathematical, scientific and logical evidences provided in chapter 2 - 5 is described below:

1- Notion of axial precession coined to justify the rising of the sun in new constellation each year and difference between the lengths of sidereal and tropical years is not a valid concept. It lacks mathematical substantiation and is based on misapprehension of the system. Axial precession of the earth with its revolution in orbit cannot provide mathematical basis for 1224.51 seconds difference between sidereal and tropical years. Generation of 24 hour day-night cycle can be validated only if the earth revolves 360° in tropical year (365.2422 days). If axis of the earth precesses then the earth must complete 360° orbital revolution in sidereal year. However, 24 hour day-night cycle cannot be rationalized with sidereal period of revolution if the earth completes axial rotation in sidereal day (23.9345 hours). Same season cannot recur after fixed interval of time if axis is supposed precessing clockwise. Axial precession does not conform to the concept and same length of sidereal year at both the poles. Angle between Polaris and Vega relative to the earth does not correspond to axial precession.

2- Axis of the earth has been assumed tilted to justify the generation of different seasons with revolution of the earth around the sun. Axis of the earth is also supposed continuously pointing towards the pole star. Mathematical analysis reveals that if the earth revolves around the sun then tilted axis cannot keep pointing continuously towards the pole star throughout the orbital motion of the earth. Distance between the earth and the pole star should be 3.7693×10^8 km if the axis is assumed tilted 23.45°. Coincidence of celestial and terrestrial axes and equatorial planes do not correspond to the tilted axis. Tilting of celestial sphere corresponding to the axial tilt of the earth cannot validate tilting of the earth as well. Visibility of the pole star at the same position from any reference point on the earth throughout the year and uniform time on the meridians at all positions of the earth in orbit cannot be justified with tilted axis. Earth's tilting is

scientifically invalid and mathematical unacceptable assumption. If the earth is proved non-tilted then generation of different seasons with orbital revolution of the earth cannot be justified and hence validity of heliocentric model becomes uncertain and doubtful.

3- Mathematical analysis reveals that the assumption “As orbit of the earth is small and the stars are far away from the earth therefore at all positions in the orbit earth-star lines will remain parallel pointing practically to the reference star after every rotation throughout the orbital motion of the earth” is mathematically invalid and scientifically irrational. Earth-star parallel lines cannot keep the reference star at the same position all along the orbit. As the circular displacement of the observer on the earth due to axial rotation causes significant change in position of the reference star so the circular displacement due to orbital revolution of the earth should also change the position/angle of view of the reference star. Visibility of the reference star at the same position/angle after each axial rotation throughout the year makes orbital revolution of the earth uncertain and ambiguous. Apparent motion and visibility of the stars do not match with orbital revolution of the earth as well. Critical and mathematical analysis reveals that the assumptions of heliocentric model are not scientifically and mathematically justified.

4- Revolution of the moon around the earth cannot be authenticated with orbital revolution of the earth around the sun. How does the moon while orbiting the earth remain linked with the earth orbiting the sun is still undetermined? Earth-moon as double planet system held together by mutual gravitational force revolving around the sun or the moon revolving independently in the orbit around the earth under the influence of gravity cannot be validated mathematically. The moon must be an independent system while orbiting the earth and it must be an interlinked earth-moon system to keep the moon associated with the earth during earth’s revolution around the sun. However, this dual nature of a physical system of two objects is not possible scientifically and there is no such example in the world of physics. Observed apparent motion of the moon and sidereal month can only be justified if the earth does not orbit the sun and the moon independently revolves around the earth under the influence of gravity. While determining orbital components of artificial satellites revolution of the earth is never considered. Revolution of artificial satellites around the earth rotating about its axis but not revolving in the orbit can be well explained and rationalized

according to the principles of gravitation. Consequently, revolution of the earth around the sun lacking scientific validity becomes suspicious.

Mathematical, scientific and logical evidences provided in chapter 2 to 5 based on observations, scientific principles and established realities provide substantial grounds for invalidity and legitimate refutation of heliocentric model of solar system. Heliocentric system is ambiguous, confusing and inconsistent with the scientific laws and observed realities. Validity and legitimacy of all the evidences can be appraised through philosophical and scientific criticism. Obviously the heliocentric apprehension of the solar system is inappropriate. Several mathematically incomprehensible complexities are associated with heliocentric model which cannot be elucidated with this model. Observations and established facts do not match with simultaneous rotation and orbital motion of the earth. Several assumptions have been made in this model which lack mathematical, scientific and logical substantiation. If one concept is corrected the other goes wrong indicating misapprehension of the system. The model does not fit with the recent and the most authentic numerical values. This model cannot be depicted in a single diagram. Several diagrams have to be presented to explain different concepts. Single physical or electronic model displaying all concepts of heliocentric model cannot be fabricated. Ultimately, it becomes evident that heliocentric concept of solar system is not a valid scientific model and needs to be rectified. Mathematical assessment of heliocentric model leads to disapproval of this model. Now no doubt is left to believe that the earth does not revolve around the sun as proposed in heliocentric model. Therefore, heliocentric notion of solar system is challenged and negated. A comprehensive model of solar system satisfying all scientific requirements best fitted with the present numerical values about relative motion of the sun, the earth, the moon and the stars is presented and explained in the next chapter.

PART – 2: NEW MODEL OF SOLAR SYSTEM

CHAPTER 7

7 THE SUN AND THE STARS ARE SET IN MOTION- "NEW MODEL OF SOLAR SYSTEM"

Whether the earth revolves around the sun or the sun revolves around the earth? This question had been a matter of debate for millennia. Several eminent scientists diligently tried to understand the true nature of the solar system. Voluminous efforts were put forth to design models for explaining relative motion of the sun and the earth. However, the solar system could not be construed in its true nature. Several factors contributed in the misapprehension throughout the historical development of various models of the solar system. Precisely determined numerical values as periods of rotation and revolution of the earth by voluminous efforts of distinguished scientists could not be implicated appropriately. The most important factor was misunderstanding or non-realization of motion of the stars (or axial rotation of celestial sphere). Careful observation of the sky for several years revealed clockwise motion of the stars that ultimately lead to disapproval of heliocentric notion about the motion of the earth and helped to develop a more precise and mathematical model of the solar system. Heliocentric model is an imperfect apprehension of the solar system that needs to be rectified. It is based on several nonscientific, irrational and mathematically unsubstantiated assumptions. Heliocentric model when subjected to rigorous mathematical assessment could not prove its validity. Legitimate refutation of heliocentric model was the eventual inference from mathematical and logical analysis of this model. New model of solar system is based on observed realities, established scientific concepts and mathematical grounds. This model does not require any assumption to validate the observed astronomical phenomena. This model completely fits with the most recent numerical values. This model has full competency to answer any question related to revolution of the sun around the earth. Axial rotation of celestial sphere is also validated logically and mathematically. No postulate in this model is based on any assumption. This model is also competent to mathematically justify sidereal and solar days, generation of different seasons without tilted earth, rising of the sun in new constellation on the day of equinox

and difference between the lengths of sidereal and tropical years. The main features and postulates of this new model are described and explained in the following pages:

7.1 Non-tilted earth occupies central position in celestial sphere

The earth occupies central position in celestial sphere. Anticlockwise axial rotation of the earth in the center of celestial sphere will keep its axis continuously pointing to the pole star (Fig-7.1). Celestial and terrestrial axes, equatorial planes and parallels will coincide in accordance with the established concept (Roddy, 2006; Shipman et al., 2015). There will be no need of any assumption. Celestial and terrestrial axes, equatorial planes and parallels cannot coincide if the earth orbits the sun with 23.45° tilted axis relative to the ecliptic. In heliocentric model, it has been assumed that as the axis of the earth remains parallel to its original position so it will keep pointing towards the pole star throughout the orbital revolution of the earth (Rohli and Vega, 2007). This assumption is proved mathematically and scientifically invalid (see 3.1.1, 3.1.2 for detail).

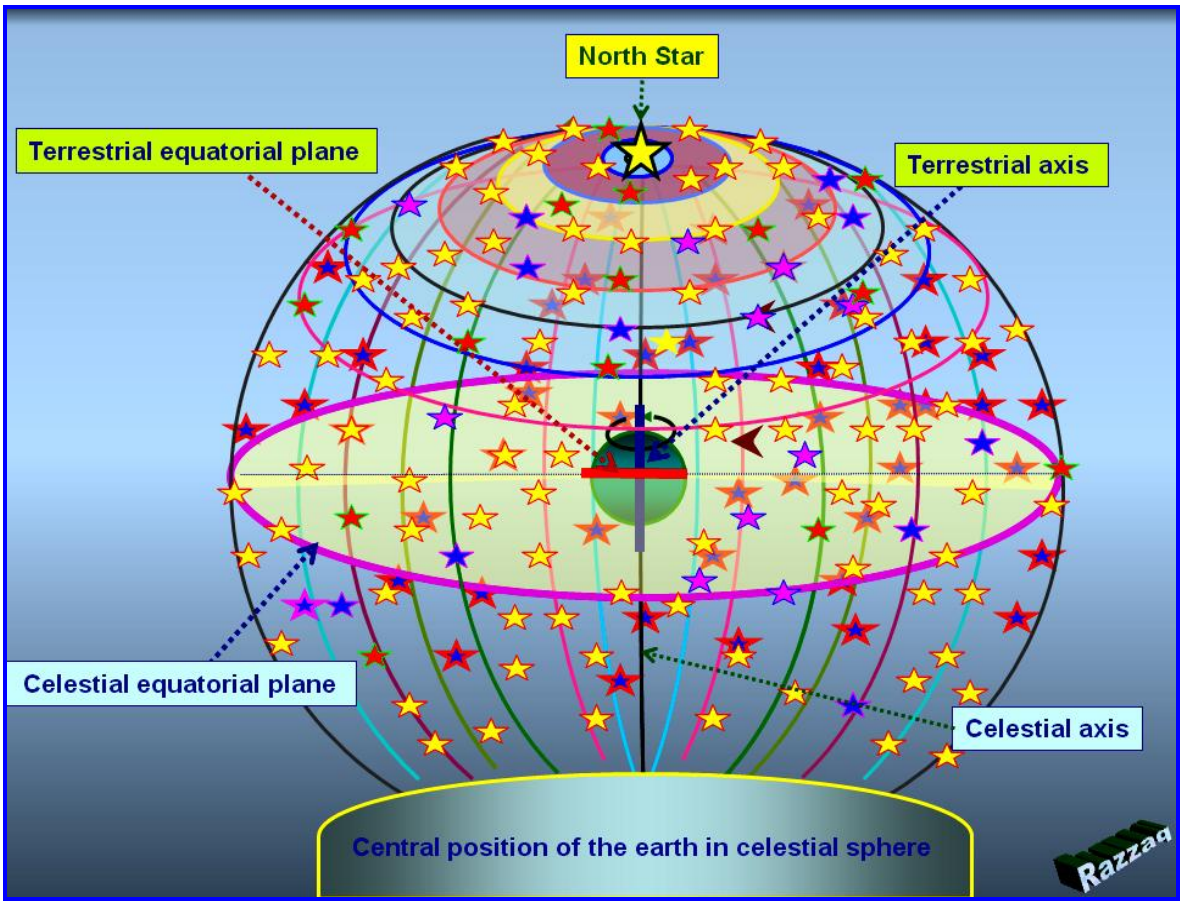

Fig – 7.1: Central position of the earth with non-tilted axis in celestial sphere.

7.2 The sun and the stars move clockwise around the earth

In heliocentric model the sun and the stars are considered stationary relative to the earth. The earth completes one axial rotation relative to the stars in about 23.9345 hours or 86164.09053083288 seconds (IERS, 2014). It means that the reference meridian of the earth will come to the same position with respect to the reference star after 23.9345 hours. The reference meridian comes to same position with respect to the sun after 24 hours. Revolution period of the earth with respect to the stars (sidereal year) is 31558149.76 seconds whereas revolution period with respect to the sun (tropical year) is 31556925.25 seconds (IERS, 2014). Obviously, the earth comes to the same position in the orbit relative to the sun earlier but takes about 1224.51 seconds more to come to the same position in orbit with respect to the stars. Earth's axial precession has been assumed responsible for this difference (Capderou, 2005; Yang, 2007). However, the earth's axial precession cannot mathematically validate this difference (see 2.3). The reference meridian, due to rotation of the earth, meets the reference star about 3.9318 minutes or 235.90946916712 seconds (86400 - 86164.09053083288) earlier than the sun but reaches to the same position in orbit with respect to the sun 1224.51 seconds (about 20 minutes) earlier than the stars. This is possible only if the sun and the stars are not stationary but revolve clockwise around the earth with different revolution periods.

7.3 The sun revolves clockwise around the earth

It is not the earth that is tilted but orbital plane of the sun (the ecliptic) makes an angle of 23.45° with equatorial plane of the earth as represented in Fig-7.2. The angle between earth's equatorial plane "a" and orbital plane of the sun "b" is 23.45°. Revolution period of the sun is 31556925.25 seconds that is called tropical year (IERS, 2014). It is the time taken by the sun to revolve 360° around the earth. Suppose the sun is at position "d" in the orbit. When the sun comes back to position "d" after completing one revolution around the earth the tropical year will be completed. Thus the tropical year is the period in which the sun completes 360° revolution around the earth. In heliocentric model tropical year cannot be established as true period for 360° revolution of the earth around the sun due to axial precession. If sidereal year is taken as period for 360° revolution then the reference meridian of the earth cannot come to the same position with respect to the sun after 24 hours with axial rotation of the earth (for detail see 2.2). If tropical

year is considered the period for 360° revolution then the earth will reach to its original position in the orbit after revolving 360°. Hence, there will be no need to assume that axis of the earth precesses clockwise. Additionally, the earth will revolve more than 360° in sidereal year and will not be in line with the reference star if the stars are stationary or the lengths of sidereal and tropical years will be same.

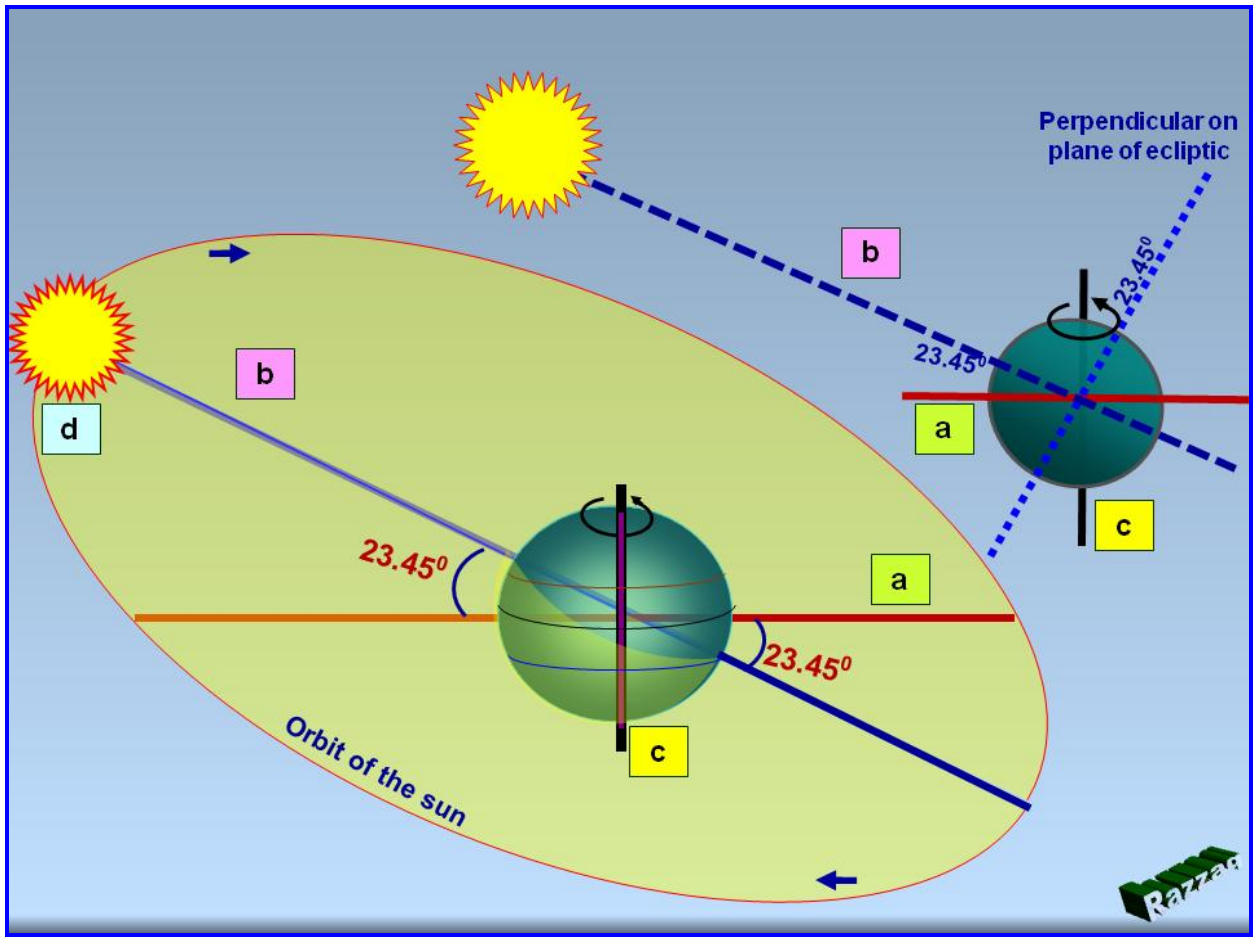

Fig – 7.2: Inclination of the ecliptic to terrestrial equator. **a:** Equatorial plane of the earth. **b:** Orbital plane of the sun; the ecliptic. **c:** Axis of the earth. **d:** Position of the sun in orbit.

7.4 Revolution of the sun and generation of four seasons

Four seasons are generated by revolution of the sun in orbit that makes an angel of 23.45° with equatorial plane of the earth. Revolution of the sun in orbit around the earth is responsible for generation of four seasons. Clockwise revolution of the sun and generation of seasons is represented in Fig-7.3a.

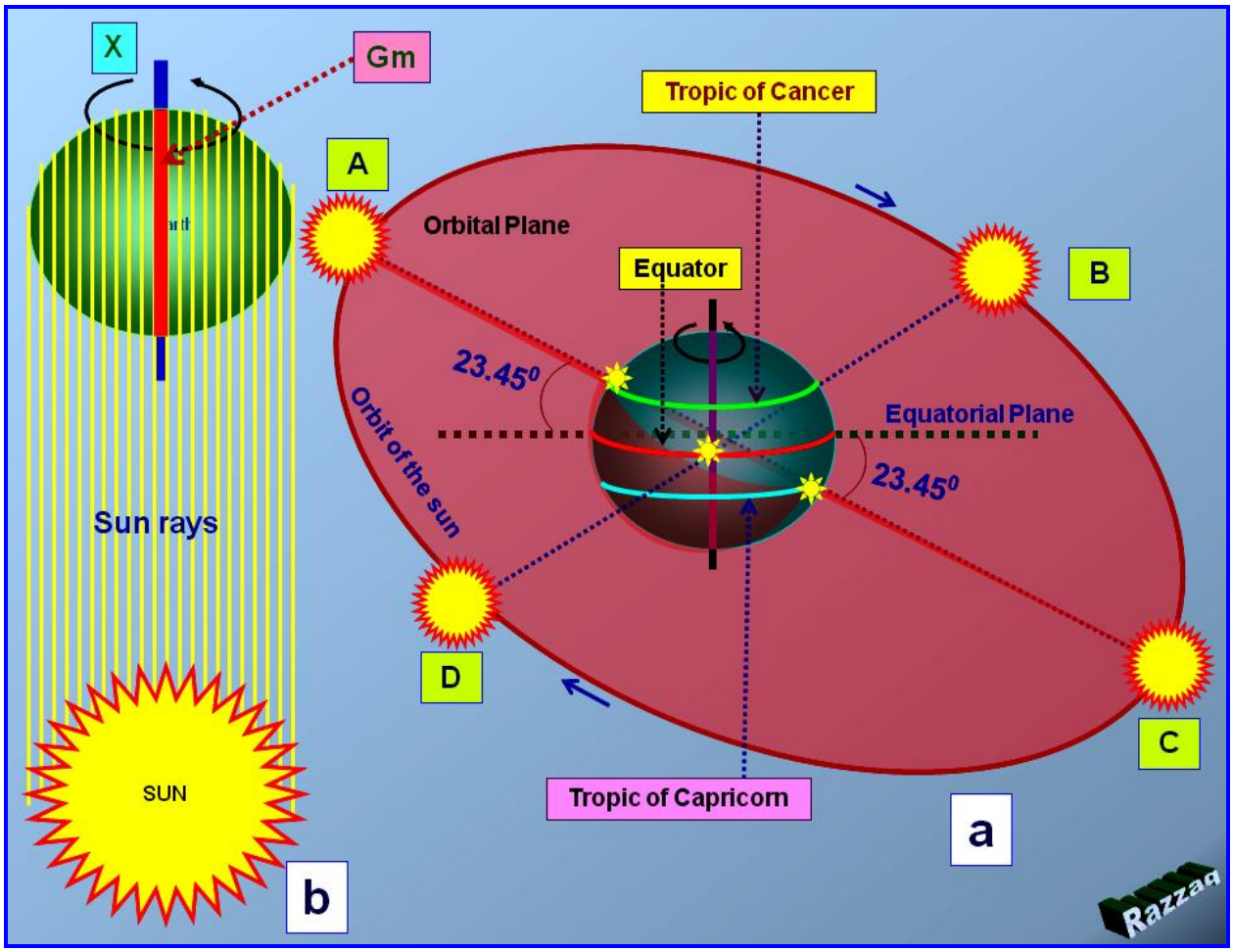

Fig – 7.3: Revolution of the sun, seasons and Greenwich meridian. **a:** Revolution of the sun around the earth and generation of different seasons. **A, B, C, D:** Positions of the sun in orbit at summer solstice, autumnal equinox, winter solstice and vernal equinox, respectively. **b:** Alignment of Greenwich meridian to the sun rays at vernal equinox for noontime. **X:** Axis of the earth, **Gm:** Greenwich meridian.

At position "A" in the orbit the sun will shine perpendicular over the tropic of Cancer so it will be summer solstice. The sun at position "B" will shine perpendicular over the equator and it will be autumnal equinox. At position "C" the sun will be shining perpendicular over the tropic of Capricorn and it will be winter solstice. The sun then goes to position "D" and shines perpendicular over the equator so it will be vernal equinox. When the sun goes back to position "A" in orbit and shines perpendicular over

the tropic of Cancer it will be summer solstice again. This is the mechanism for generation of four seasons without tilting of the earth. The earth was assumed tilted 23.45° to justify generation of four seasons in heliocentric model (Moore, 2002; Plait, 2002; Rohli and Vega, 2007). However, it is proved logically and mathematically that the earth is not tilted (see 3.1, 3.2 for detail).

7.5 Revolution of the sun, non-tilted earth and uniform time on meridians

When the sun will be revolving around the earth with non-tilted axis in the orbit inclined 23.45° to the plane of terrestrial equator, all the length of reference meridian/longitude will have same position relative to the sun rays throughout the year. Therefore, same time will be observed all over the length of the meridian. Alignment of Greenwich meridian “Gm” of the earth at noontime with non-tilted axis “X” to the sun rays at the point of vernal equinox is depicted in Fig-7.3b. All the length of Greenwich meridian will have same alignment to the sun rays throughout the year and hence same time will be observed at all points of the meridian in accordance with the established fact (Feeman, 2002; Stern, 2004). If the earth revolves around the sun with tilted axis then Greenwich meridian cannot have parallel alignment to the sun rays throughout the orbit for noontime. Consequently, same time cannot be observed throughout the length of the meridian (see 3.2 for detail).

7.6 Rotation of celestial sphere - Rationalization

Whether the stars move or not? To determine the motion of the stars is very important for understanding the solar system. Defining the movement of the stars will make it easier to understand the motion of other celestial bodies relative to the earth. Axial rotation of the earth brings the reference meridian on the earth to the same position relative to the reference star after 86164.09053083288 seconds (the length of sidereal day) and to the same position with respect to the sun after 86400 seconds or 24 hours. In other words, the reference meridian meets the reference star 235.90946916712 seconds (86400 – 86164.09053083288) earlier than the sun due to rotation of the earth. The sun comes to the same position of the earth later than the reference star. The interval between the visibility of the sun and the reference star at the same position from the reference point on the earth increases every sidereal day. This means that the reference star and the sun move apart. In other words the sun recedes with respect to

the reference star. As the sun moves clockwise so the stars should also be moving clockwise. Visibility of the reference star over the same meridian of the earth earlier than the sun and recession of the sun relative to the stars is possible only if the stars move clockwise faster than the sun. Revolution of the sun and time difference created between the visibility of the reference star and the sun over the same meridian after discrete number of sidereal days is calculated below:

i) Time difference created with 1, 91, 183, 274 and 366 sidereal days
Time difference created with
1 sidereal day = (86400 - 86164.09053083288) = 235.90946916712 s
91 sidereal days = {(235.90946916712 x 91) ÷ 3600} = 5.96326714 h
183 sidereal days = {(235.90946916712 x 183) ÷ 3600} = 11.99206468 h
274 sidereal days = {(235.90946916712 x 274) ÷ 3600} = 17.95533182 h
366 sidereal days = {(235.90946916712 x 366) ÷ 3600} = 23.98412937 h
ii) Revolution of the sun after 1, 91, 183, 274 and 366 sidereal days
Revolution period of the sun = 31556925.25 s/360°
Length of sidereal day = 86164.09053083288 s
Revolution in 1 sidereal day =
{(360 ÷ 31556925.25) x 86164.09053083288} = 0.98295611°
in 91 sidereal days = 89.44900631°
in 183 sidereal days = 179.88096873°
in 274 sidereal days = 269.32997504°
in 366 sidereal days = 359.76193746°

Let us suppose that the sun is at point “A” in the orbit, the reference star is at position “L” and both the sun and the stars are aligned with Greenwich meridian “Gm” indicated by blue line in Fig-7.4a. After one sidereal day Greenwich meridian will be facing the reference star at position “M” but the sun will be at position “B” with revolution of 0.98295611°. The reference meridian will meet the sun after 235.90946916712 seconds or about 3.9318 minutes. After 91 sidereal days the reference star at position “N” will be aligned with the Greenwich meridian whereas the sun after revolving 89.44900631° will be at position “C”. The reference meridian will come to the same position relative to sun after 5.96326714 hours. Greenwich meridian will be at the same position with respect to the reference star at position “L” after 183 sidereal days and the sun will be at position “D” with 179.88096873° revolution in the orbit. Consequently the sun and the reference star will be almost at opposite positions relative to the earth. The earth needs to rotate for 11.99206468 hours to bring the reference meridian at the same position relative to

the sun. This implies that the reference star will have almost reached to its initial position when the sun revolves 179.88096873°. In other words the reference star will have almost completed one revolution when the sun revolves about 180°. The sun from position “D” will go to position “E” after revolving 269.32997504° and the reference star will go to position “P” from “O” and will be aligned with Greenwich meridian (Fig7.4b) after 274 sidereal days. Now the reference star will be following the sun. The reference meridian will come to the same position relative to the sun after an interval of 17.95533182 hours.

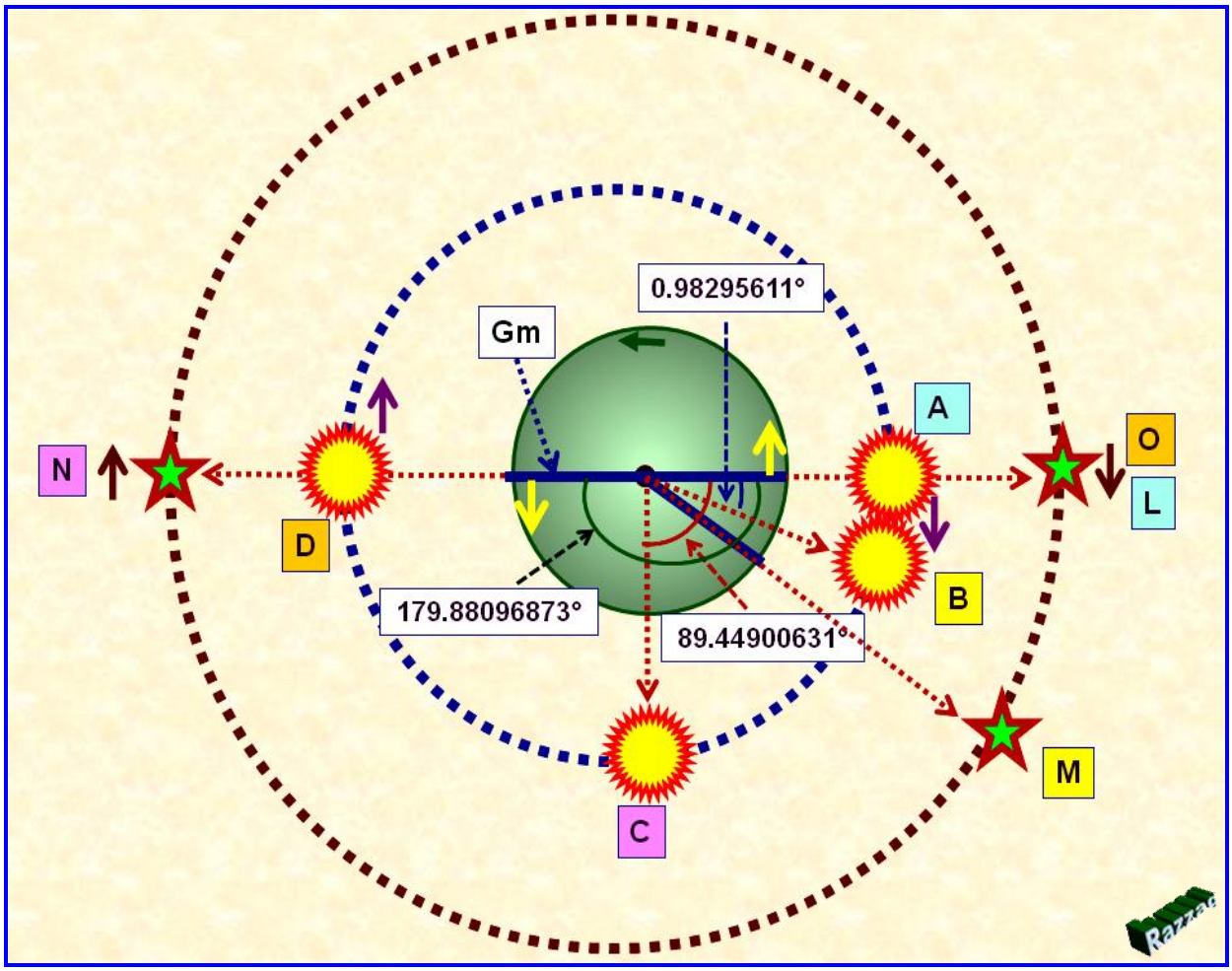

Fig – 7.4a: Revolution of the sun and rotation of celestial sphere. **Gm (blue line):** Greenwich meridian. **A:** Initial position of the sun in the orbit. **B, C**, **D:** Positions of the sun in the orbit after 1, 91 and 183 sidereal days, respectively. **L:** Initial position of the reference star. **M, N**, **O:** Positions of the reference star after 1, 91, and 183 sidereal days, respectively.

After 366 sidereal days the sun with revolution of 359.76193746° will be at position “F” getting almost to its initial position “A” in the orbit whereas the reference star will be at position ”Q” and appears at the same position with respect to the reference meridian.

The sun reaches to its initial position earlier than the stars. Therefore, the reference star will be away from its initial position “O” when the sun reaches to its initial position in the orbit after tropical year. Consequently, the sun will complete 360° revolution in tropical year but the reference star and the sun will not be in line with the earth.

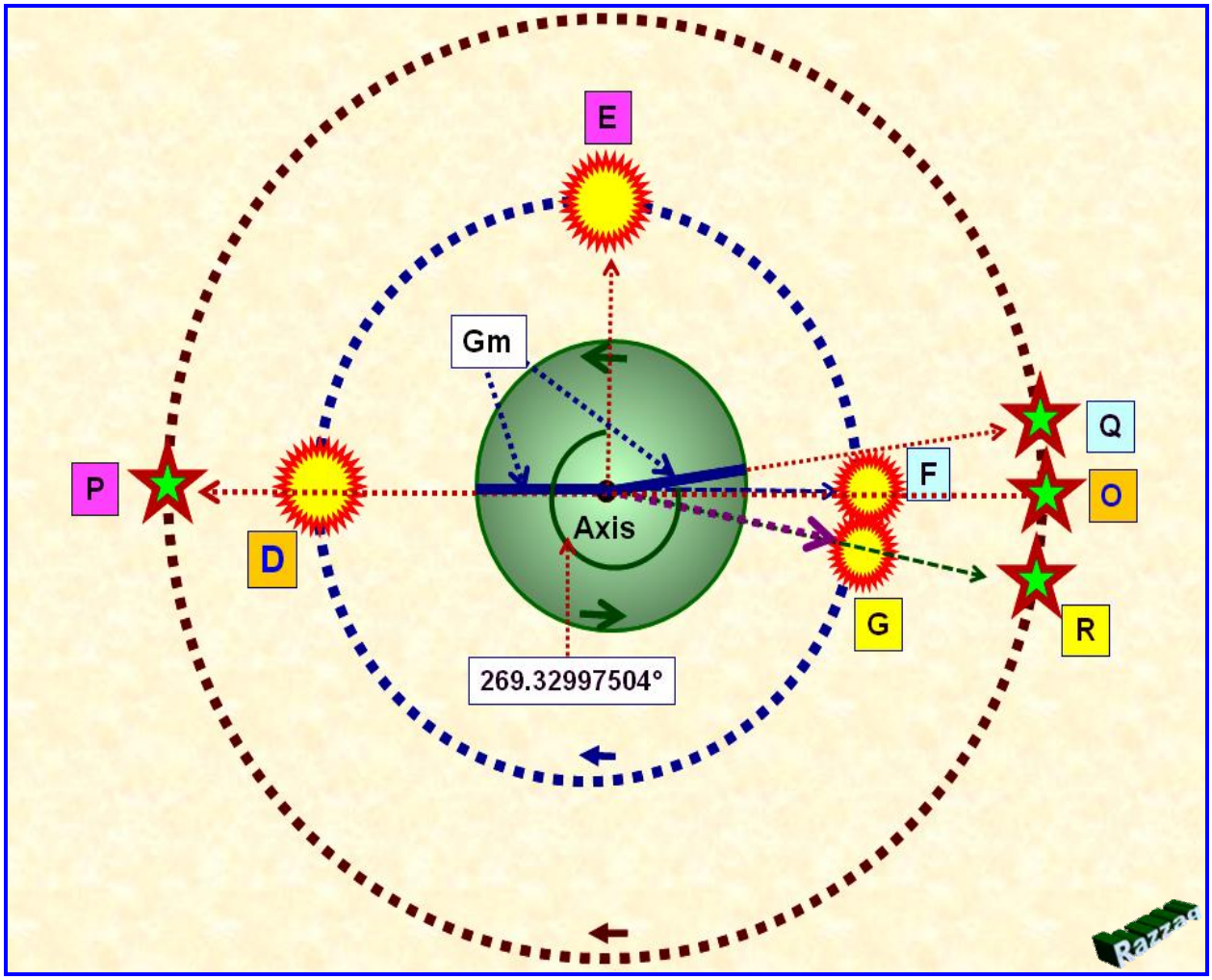

Fig – 7.4b: Revolution of the sun and rotation of celestial sphere. **Gm:** Greenwich meridian. **D, E, F:** Positions of the sun in the orbit after 183, 274 and 366 sidereal days, respectively. **O, P, Q:** Positions of the reference star after 183, 274 and 366 sidereal days, respectively. **G**, **R:** Positions of the sun and the reference star, respectively, after sidereal year.

Sidereal year is the time in which the earth, the sun and the reference star come to same relative positions again (Ball, 2013; Silen, 2010). When the sun goes to position “G” the star will reach at position “R”. Consequently the reference star, the sun and the earth will be in line again thereby completing the sidereal year. Obviously the sun reaches to point “G” after revolving a little more than 360° whereas the star will have revolved a little more after completing second revolution to reach at position “R”. Hence completion of sidereal year will take more time than that of tropical year.

Thus clockwise rotation of celestial sphere, clockwise revolution of the sun and anticlockwise axial rotation of the earth not only validate the shorter sidereal day than the solar day but also authenticate longer sidereal year than the tropical year. There is no need for any assumption. In heliocentric model it is assumed that "as the earth-star lines remain parallel so the same meridian will be facing the same star after sidereal day at all positions of the earth in the orbit" (Wertz, 2012) to justify the difference between solar and sidereal days. Clockwise precession of earth's axis has been assumed to validate the shorter length of tropical year than the sidereal year (Capderou, 2005; Yang, 2007). However, it has been proved that these assumptions are not valid mathematically and logically (see chapter 2 and 4.1 for detail).

7.7 Rotation period of celestial sphere

The sun and the stars align with the earth after sidereal year. Revolution period of the sun is known. Therefore, revolution period of the stars or more appropriately the rotation period of celestial sphere can be determined as follows:

i) **Revolution of the sun in sidereal year (31558149.76 s) =**

{(360 ÷ 31556925.25) x 31558149.76} = 360.013969155629°

(Revolution period of the sun = 31556925.25 s/360°)

The sun and the reference star align with the earth after sidereal year. The celestial sphere should rotate 720.013969155629° and the sun should revolve 360.013969155629° in sidereal year to align with the earth again.

ii) Rotation period of celestial sphere =

{(31558149.76 ÷ 720.013969155629) x 360) =

15778768.746560750383872513756203 s or 15778768.746560750384 s

Thus period of axial rotation of celestial sphere is 15778768.746560750384 seconds per 360°. This period of rotation of celestial sphere with 31556925.25 seconds per 360° revolution period of the sun can mathematically substantiate the lengths of sidereal day, solar day, solar year, sidereal year and rising of the sun in new constellation on the day of equinox without any assumption. The North Star located at the North Pole of celestial sphere does not appear to move in accordance with the observation (Narlikar, 1996; Williams, 2003).

7.8 Rising of the sun in new constellation

The sun rises in new constellation after tropical year. This phenomenon has been observed since centuries (Heath, 1991). Mathematical justification for rising of the sun in new constellation every tropical year is elucidated here. Suppose that the sun is at point "A" in the orbit and shines perpendicularly above the equator whereas the reference star is at position "X" (Fig-7.5). The sun and the reference star are in line with the earth.

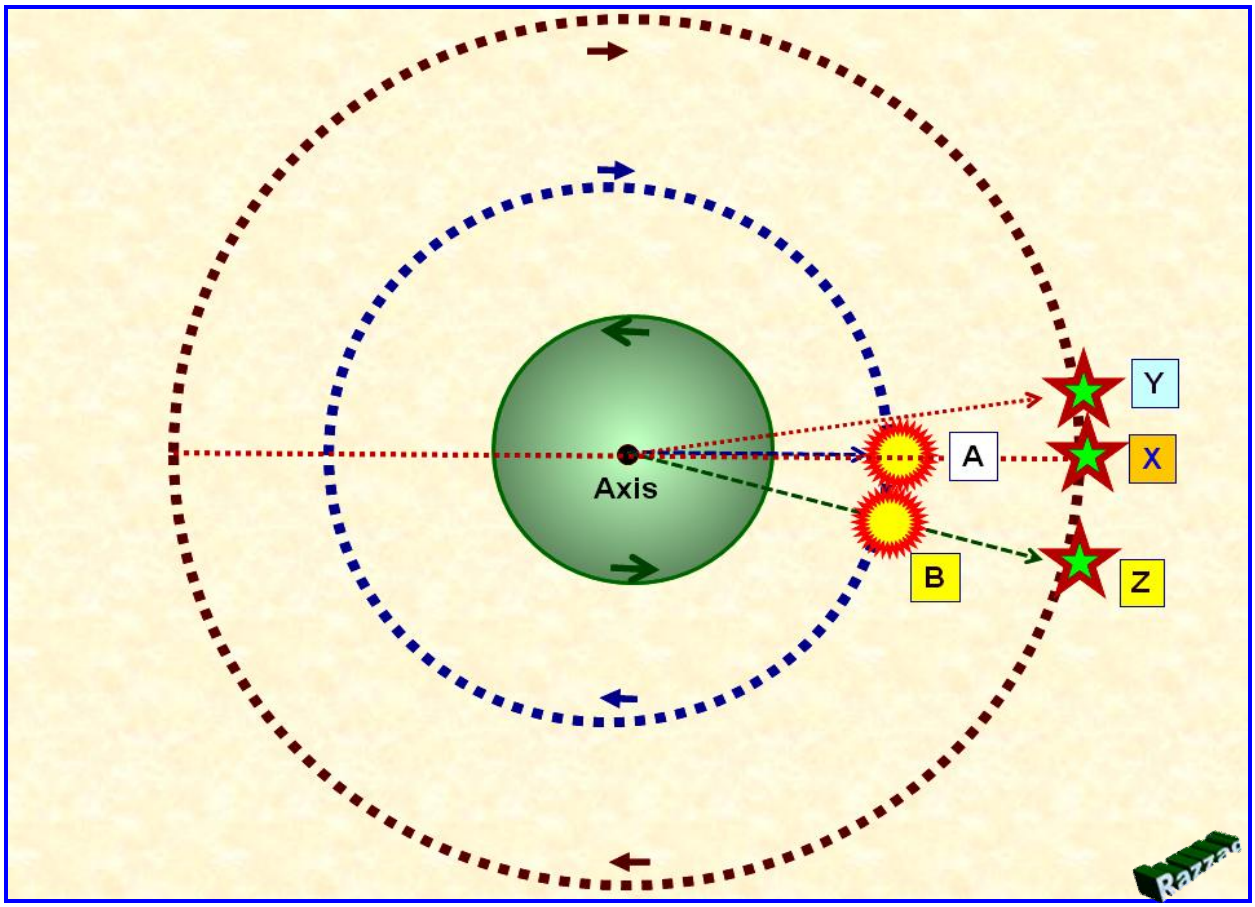

Fig – 7.5: Relative positions of the sun and the reference star after tropical and sidereal years. **A:** Initial and position of the sun in the orbit after tropical year. **B:** Position of the sun after sidereal year. **X:** Initial position of the reference star. **Y, Z:** Positions of the reference star after tropical and sidereal year, respectively.

Revolution of the sun and rotation of celestial sphere in tropical year is calculated below:

i) Revolution of the sun in tropical year (31556925.25 s) = 360°

ii) Rotation of celestial sphere in tropical year

Rotation period of celestial sphere = 15778768.746560750384 s/360°

Rotation of celestial sphere in 31556925.25 s (tropical year)

= 719.986031386398°

iii) Angular difference in positions of the reference star and the sun

= 0.013968613602° or 50.2870089672 arc seconds

After one tropical year the sun after completing 360° revolution will come to position “A” again and will be shining perpendicularly over the equator. However, the celestial sphere will have rotated 719.986031386398° in tropical year and the reference star will be at position “Y”. The sun will not be aligned with the same star. The sun on the day of equinox will be facing another star (or constellation). Thus the sun will rise in new constellation on the day of equinox in accordance with the observed reality (Heath, 1991). The reference star at position “Y” will be 0.013968613602° or 50.287 arc-seconds away from its initial position. The angular difference in position of the sun and the reference star is similar to the reported value of precession (Daintith, 2008; IERS, 2014).

Concept of axial precession was coined to justify this difference in positions of the sun and the reference star with respect to the earth after tropical year but this difference was never justified mathematically. Sufficient mathematical and scientific evidences have been provided for legitimate refutation of the concept of axial precession of the earth (see chapter 2). Clockwise axial rotation of the celestial sphere was the missing link for misunderstanding of the solar system. Therefore, rising of the sun in new constellation and difference between the lengths of sidereal and tropical years could not be validated mathematically. Clockwise revolution of the sun around the earth and clockwise axial rotation of celestial sphere perfectly validate the observed facts. The reference star will be lagging behind the sun after tropical year. Therefore the sun will appear in a new constellation after tropical year on the day of equinox.

7.9 Mathematical validation for difference between sidereal and tropical years

The sun reaches to position “A” again after completing 360° revolution in the orbit (revisit Fig-7.5). However the reference star will be at position “Y” after 719.986031386398° axial rotation of celestial sphere. The sun and the reference star have to align with the earth after sidereal year (Silen, 2010; Kelley & Milone, 2011). Revolution of the sun and rotation of celestial sphere in sidereal year is calculated below:

i) Revolution of the sun in sidereal year

Revolution period of the sun = 31556925.25 s / 360°

Length of sidereal year = 31558149.76 s

Revolution of the sun in sidereal year =

{(360 ÷ 31556925.25) x 31558149.76} = 360.013969155629°

ii) Rotation of celestial sphere in sidereal year =

{(360 ÷ 15778768.746560750384*) x 31558149.76} = 720.013969155629°

*** Rotation period of celestial sphere**

The sun after revolving 360.013969155629° will go to position “B” from its initial position “A” whereas the reference star will go to position “Z” from its initial position “X” with 720.013969155629° rotation of celestial sphere in sidereal year. Consequently the sun and the reference star will align again with the earth after sidereal year. The sun comes to position “A” again after revolving 360° in tropical year whereas the reference star reaches to position “Y” after 719.986031386398° clockwise rotation of celestial sphere during this time (see equation ii, section 7.8). The sun needs to revolve 0.013969155629° (360.013969155629° - 360°) to go to position “B” from “A” while the reference star needs to move 0.027937769231° (720.013969155629° - 719.986031386398°) to go to position “Z” from “Y”. Time taken by the sun to reach at point “B” in the orbit from “A” and time needed by the star to go to position “Z” from “Y” is calculated below:

iii) Time taken by the sun to revolve 0.013969155629°

= {(31556925.25 ÷ 360) x 0.013969155629°) = 1224.51 s

iv) Time taken by celestial sphere to revolve 0.027937769232°

= {(15778768.746560750384 ÷ 360) x 0.027937769232} = 1224.51 s

Obviously, the sun takes 1224.51 seconds to reach at position “B” from “A”. Celestial sphere also needs 1224.51 seconds to rotate for taking the reference star from position “Y” to “Z”. Hence, the sun and the reference star will take 1224.51 seconds more, after tropical year, to come in line with the earth. Thus difference of 1224.51 seconds between sidereal and tropical years is mathematically substantiated. There is no way to mathematically validate this difference between the lengths of sidereal and tropical years with the concept of axial precession in heliocentric model (see 2.3).

7.10 Rotation period of the earth

Observer on the earth comes to same position with respect to the sun after every 24 hours. The sun revolves 360° in 31556925.25 seconds (length of tropical year).

Suppose the sun is at position “A” in the orbit as depicted in Fig-7.6.

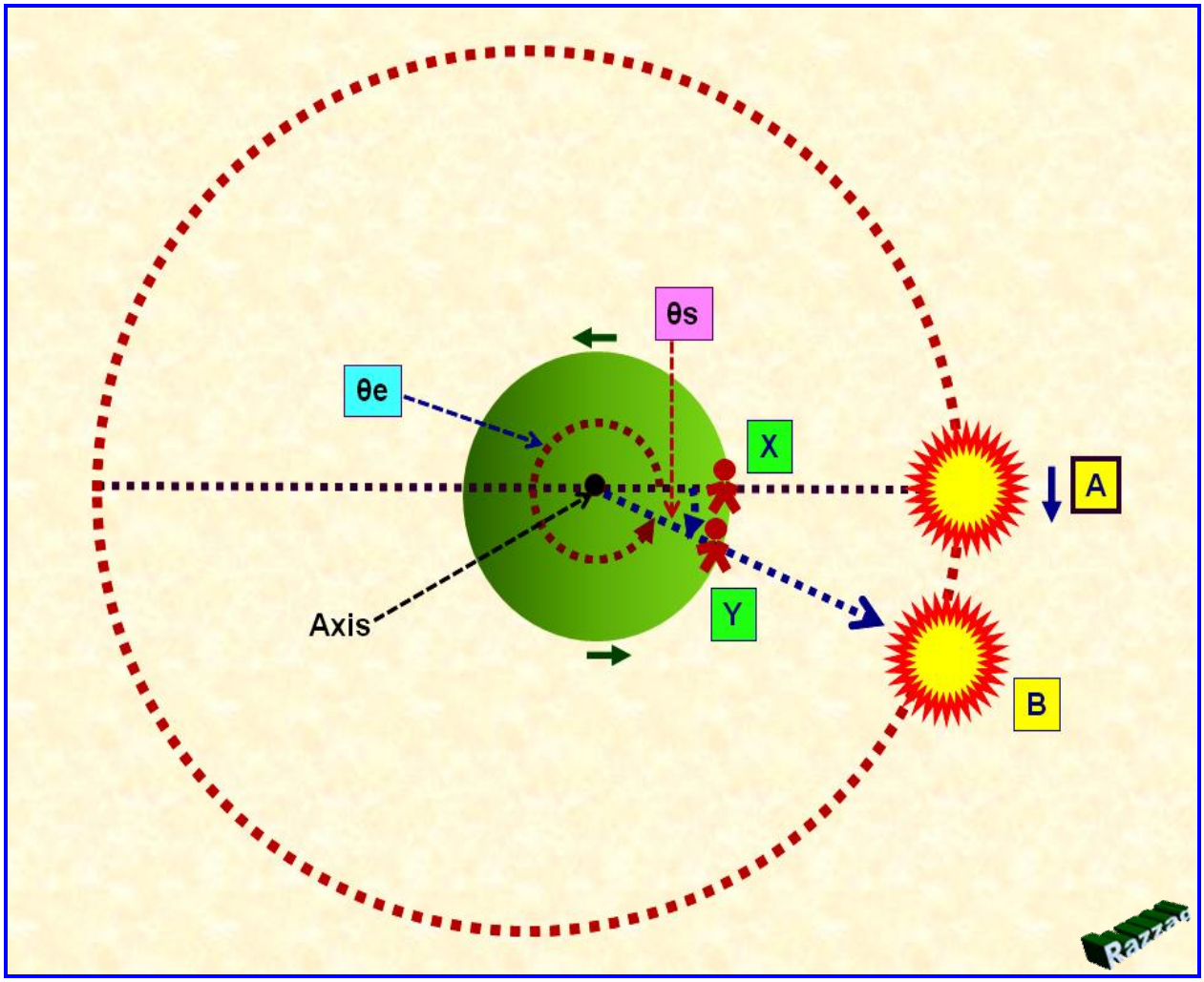

Fig – 7.6: Anticlockwise axial rotation of the earth and clockwise orbital revolution of the sun in solar day. **A:** Initial position of the sun. **B:** Position of the sun after 24 hours. **X:** Initial position of the observer on the earth. **Y:** Position of the observer after 24 hour axial rotation of the earth. **θs:** Angular displacement of the sun in 24 hours with respect to the center of the earth. **θe:** Angular displacement of the observer in 24 hours.

The sun revolves “θs” in 24 hours (86400 seconds) and goes to position “B”. The earth needs to rotate “θe” in this time to take the observer on the earth to same position relative to the sun. Period for 360° rotation of the earth about its axis can be calculated as follows:

i) Period for 360° axial rotation of the earth

Revolution period of the sun = 31556925.25 s

Revolution of the sun (θs) in 24 hours (86400 s) =

{(360 ÷ 31556925.25) x 86400} = 0.985647358023°

Rotation of the earth (θe) required to match the position of the sun =

360 - 0.985647358023 = 359.014352641977°

Period for 360° axial rotation = {(86400 ÷ 359.014352641977) x 360}

= 86637.204811190751 s or 24.065890225331 hours

Thus the earth rotates 360° about its axis in 86637.204811190751 seconds. This is the true rotation period of the earth. In heliocentric model period for 360° axial rotation of the earth with respect to the stars is about 23.9345 hours (Crystal, 1994; IERS, 2014). However, it has been mathematically confirmed that the same star cannot be viewed at the same position if the earth revolves in the orbit (see 4.1.1, 4.1.2). Therefore, 23.9345 hours (sidereal day) cannot be considered true period for 360° axial rotation of the earth. Actually, the observer on the earth comes to the same position with respect to the reference star after sidereal day (23.9345) and comes to the same position with respect to the sun in solar day (24 hours).

7.11 Completion of sidereal and solar days

The earth rotates anticlockwise about its axis. The sun and the stars move around the earth clockwise. The sun revolves with speed less than the stars. The observer with rotation of the earth will face the same star earlier than the sun. Mathematical basis for generation of sidereal and solar days due to anticlockwise rotation of the earth, clockwise revolution of the sun and clockwise axial rotation of celestial sphere is given below:

i) Axial rotation of the earth in sidereal day

Rotation period of the earth = 86637.204811190751 s

Length of sidereal day = 86164.09053083288 s

Anticlockwise rotation of the earth in sidereal day (θ1)

= {(360 ÷ 86637.204811190751) x 86164.09053083288

= 358.034087765181°

Ii) Rotation of celestial sphere in sidereal day

Rotation period of celestial sphere = 15778768.746560750384 s

Clockwise rotation of celestial sphere in sidereal day (θr)

= {(360 ÷ 15778768.746560750384) x 86164.09053083288) = 1.965874086206°

iii) Revolution of the sun in solar day

Length of solar day = 86400 s (24 hours)

Clockwise revolution of the sun in solar day (θs)

= {(360 ÷ 31556925.25) x 86400} = 0.985647358023°

iv) Anticlockwise rotation of the earth in solar day (θ2)

{(360 ÷ 86637.204811190751) x 86400} = 359.014352641977°

Let the reference star be at position "A", the sun at position "P" in the orbit and observer on the earth at position "X" as shown in Fig-7.7.

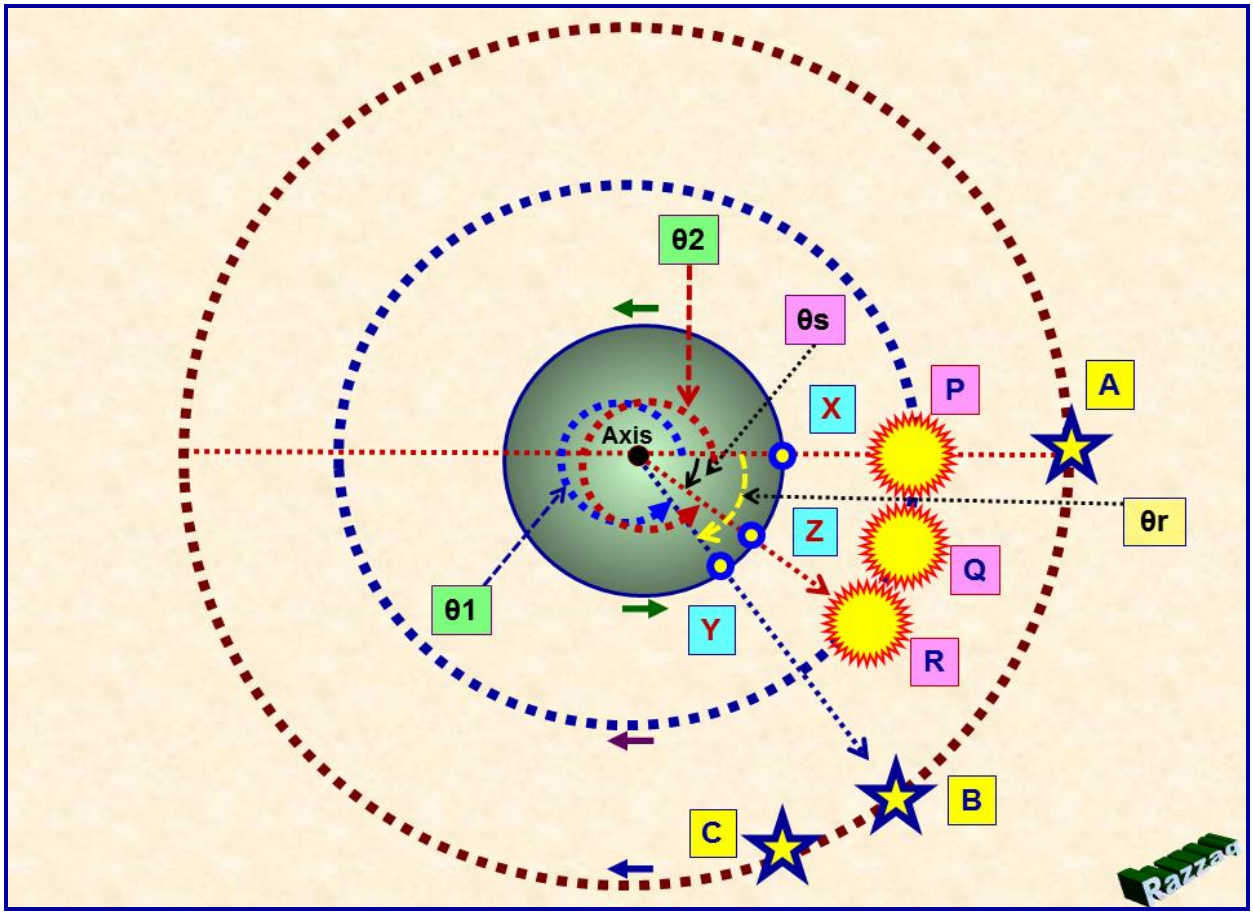

Fig – 7.7: Anticlockwise rotation of the earth, clockwise rotation of celestial sphere, clockwise revolution of the sun, solar and sidereal days. **A:** Initial position of the reference star. **B, C:** Positions of the star after sidereal and solar days, respectively. **X:** Initial position of the observer on the earth. **P:** Initial position of the sun in the orbit. **Q, R:** Positions of the sun after sidereal and solar days, respectively. **Y**, **Z:** Positions of the observer after sidereal and solar days, respectively.

The earth will rotate "θ1" (358.034087765181°) anticlockwise in sidereal day taking the observer to position "Y". The reference star will go to position "B" in sidereal day with "θr" (1.965874086206°) clockwise axial rotation of celestial sphere. Thus the observer and the reference star will align again thereby completing the sidereal day. However the

sun will be at position “Q” in this time. So the observer will meet the reference star earlier than the sun.

The observer with “θ2” (359.014352641977°) rotation of the earth will be at position “Z” and the sun will go to point “R” in the orbit with “θs” (0.985647358023°) clockwise revolution in 24 hours. The observer will be at the same position with respect to the sun thereby completing the solar day. The reference star in 24 hours will have moved to position “C”.

Thus, anticlockwise rotation of the earth takes the observer to the same position relative to the reference star earlier than the sun. A little more anticlockwise rotation of the earth and clockwise revolution of the sun for about 3.9318 minutes will take the observer to the same position relative to the sun. There will be no need to assume that earth-star parallel lines will bring the same star at the same position to the observer on the earth after every sidereal day at all positions in the orbit (Dunkin, 2010; Gray, 2008; Wertz, 2012). It has been verified mathematically and logically that despite the observer-star lines remain parallel the same star cannot be viewed at the same position after every rotation if the earth revolves in the orbit (4.1.1, 4.1.2).

7.12 Completion of solar year

Anticlockwise rotation of the earth and clockwise revolution of the sun brings the reference meridian of the earth to the same position relative to the sun after discrete number of solar days (24 hour). Therefore, the reference meridian should come to the same position with respect to the sun after solar year i.e. 365 days. Revolution of the sun and axial rotation of the earth in solar year (365 x 86400 = 31536000 seconds) is calculated below:

i) Revolution of the sun in solar year
= {(360 ÷ 31556925.25) x 31536000 = 359.7612856784898°
ii) Rotation of the earth in solar year
= {(360 ÷ 86637.204811190751*) x 31536000}
= 131040.238714321509°
or 364 complete rotations + 0.2387143215090°
*** Rotation period of the earth**

The sun will revolve 359.7612856784898° clockwise during solar year and the earth will have rotated 0.2387143215090° anticlockwise after completing 365 rotations. Therefore the reference point on the earth will be at the same position with respect to the sun. In

heliocentric model 31556925.25 seconds (tropical year) cannot be considered true period for 360° revolution of the earth in the orbit if axis of the earth is assumed precessing. Sidereal year, if considered revolution period, cannot take the reference meridian to the same position relative to the sun after 365 days with sidereal day as rotation period of the earth (refer to section 2.2 for detail).

7.13 Revolution of the moon

The moon revolves around the earth in the orbit inclined 5.14° to the ecliptic (Lang, 2012). However several contradictory and mathematically undefined postulates have been proposed to describe the motion of the moon in the orbit (see 5.1.1 to 5.1.6). The moon comes to the same position with respect to the sun after synodic month and the same position with respect to the stars in sidereal month (Zahn and Stavinschi, 2012; Espenak, 2012). Sidereal month is considered true period for 360° revolution of the moon in the orbit. The earth moves around the sun while the moon revolves around the earth. Therefore, it has been assumed (Denecke and Carr, 2006; Millham, 2012; Whipple, 1968) that as the stars are far away and the moon-star lines remain parallel therefore moon will come to the same position with respect to the reference star after every sidereal month. However, this assumption is not valid mathematically (see 5.2). Mathematical substantiation of the synodic and the sidereal months is possible only with clockwise revolution of the sun, clockwise rotation of celestial sphere and anticlockwise revolution of the moon around the earth.

Let us suppose that the reference star is at position “A”, the sun at “P” and the moon at position “X” as depicted in Fig-7.8. The star with clockwise rotation of celestial sphere will go to position “B” whereas the moon will reach to position “Y” with anticlockwise revolution “θ1” in the orbit. The moon will be at the same position with respect to the reference star thus completing the sidereal month. There will be no need for any assumption to justify completion of sidereal month. Nonetheless, the sun will have reached to point “Q” in the orbit during sidereal month. The moon after revolving “θ2” will go to position “Z” and the sun reaches to position “R”. Now the moon will be at the same position with respect to the sun thereby completing the synodic month. However, the reference star will have gone to position “C” during this period.

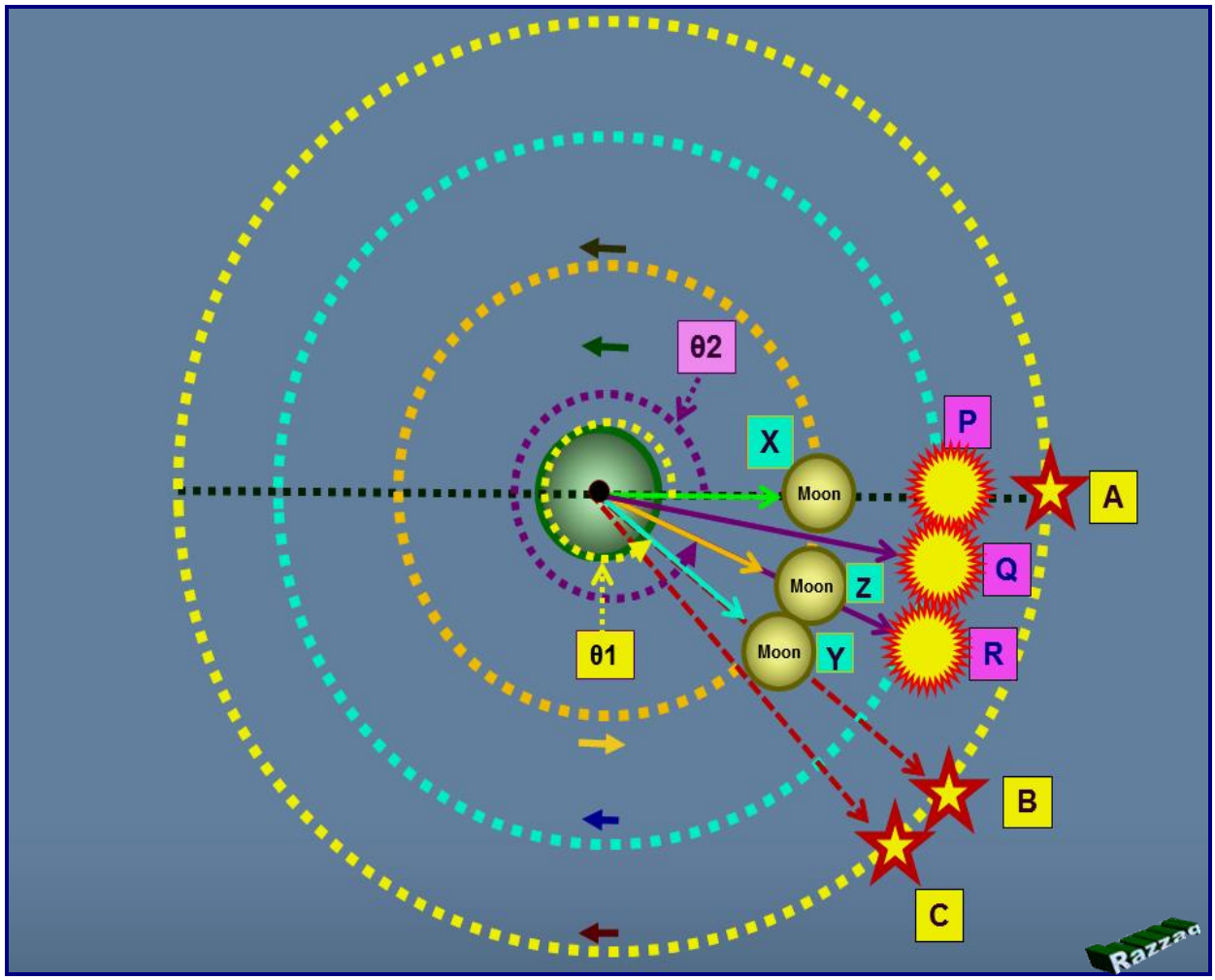

Fig – 7.8: Clockwise rotation of celestial sphere, clockwise revolution of the sun, sidereal and synodic months of the moon. **A:** Initial position of the reference star. **B, C:** Positions of the reference star after sidereal and synodic months of the moon, respectively. **P:** Initial position of the sun. **Q, R:** Positions of the sun after sidereal and synodic months of the moon, respectively. **X:** Initial position of the moon. **Y, Z:** Positions of the moon after sidereal and synodic months, respectively. **θ1**, **θ2:** Revolution of the moon in sidereal and synodic months, respectively.

Length of sidereal month is 27 days 7 hours 43 minutes 11.47 seconds or 2360591.47 seconds (The Columbia E Enc., 2007; Whipple, 2007). Whereas length of synodic month is 29 days, 12 hours, 44 minutes and 2.78 seconds or 2551442.78 sec (Williams, 2009). Therefore, moon's period for 360° revolution around the earth based on revolution period of the sun and/or rotation period of celestial sphere may be calculated as follows:

i) Revolution period of the moon based on rotation period of celestial sphere
Length of sidereal month = 2360591.47 s
Rotation period of celestial sphere = 15778768.746560750384 s
Rotation of celestial sphere in sidereal month =
{(360 ÷ 15778768.746560750384) x 2360591.47} = 53.858000129778°

Revolution of the moon needed to align with the star =
(360 - 53.858002135714) = 306.141999870222°
Revolution period of the moon =
{(2360591.47 ÷ 306.141999870222) x 360} =
2775878.283803747562 s or 32.128220877358 d

ii) Revolution period of the moon based on revolution period of the sun
Length of synodic month = 2551442.78 s
Revolution period of the sun = 31556925.25 s
Revolution of the sun in synodic month =
{(360 ÷ 31556925.25) x 2551442.78} = 29.106745778409°
Revolution of the moon needed to align with the sun =
(360 - 29.106745778409) = 330.893254221591°
Revolution period of the moon =
{(2551442.78 ÷ 330.893254221591) x 360}
= 2775878.290298690567 s or 32.128220952531 d

"Revolution period of moon calculated based on rotation period of celestial sphere and revolution period of the sun is almost same with a difference of 0.006494943005 seconds."

Thus the moon will revolve 360° around the earth in 2775878.283803747562 seconds. Consequently sidereal month is not true revolution period of the moon. This is the time in which the moon comes to the same position with respect to the reference star. Synodic month is the time in which moon comes to the same position with respect to the sun. Length of synodic month is 29 days, 12 hours, 44 minutes and 2.78 seconds or 2551442.78 sec (Williams, 2009). Mathematical elaboration for completion of synodic month is given below:

iii) Revolution of the moon in synodic month
= {(360 ÷ moon's revolution period) x synodic month}
= {(360 ÷ 2775878.405379468614) x 2551442.78}
= 330.893254995808°

iv) Revolution of the sun in synodic month
= {(360 ÷ revolution period of the sun) x synodic month}
= {(360 ÷ 31556925.25) x 2551442.78} = 29.106745778409°

The moon revolves 330.893254995808° anticlockwise while the sun revolves 29.106745778409° clockwise during synodic month. Therefore the moon will be at the same position with respect to the sun after synodic month.

Consequently, clockwise revolution of the sun and rotation of the celestial sphere can mathematically validate the observed lengths of moon's sidereal and synodic months without any assumption. Hence this model distinctly and mathematically defines, revolution period, sidereal month and synodic months of the moon without any assumption.

7.14 Summary of new model of solar system

The new model is completely depicted in Fig-7.9. The earth is positioned in the center of celestial sphere and rotates anticlockwise about its axis (TA) with rotation period of 86637.204811190751 seconds or 24.065890225331 hours/360°. The axis will remain directed towards the celestial North Pole or North Star (NS) permanently. Celestial axis (CA) and terrestrial axis (TA), equatorial planes (CE, TE) and parallels will coincide. The sun revolves clockwise around the earth with revolution period of 31556925.25 seconds/360°. The orbital plane of the sun (E) makes an angle of 23.45° (θ1) with celestial and terrestrial equatorial planes. Clockwise revolution of the sun around the earth generates four seasons.

Celestial sphere rotates clockwise with rotation period of 15778768.746560750384 seconds/360°. The earth rotates 358.034087765181° anticlockwise about its axis whereas celestial sphere rotates 1.965874086206° clockwise in sidereal day. Thus the reference star will be at the same position relative to the reference point on the earth after sidereal day. The sun revolves 0.985647358023° clockwise and the earth rotates 359.014352641977° anticlockwise in 24 hours. Therefore same meridian of the earth will be at the same position relative to the sun after solar day (24 hours). Clockwise rotation of celestial sphere with higher angular speed than clockwise revolution of the sun makes the sidereal day 235.90946916712 seconds (3.9318 minutes) shorter than the solar day. The sun revolves 360° whereas the celestial sphere rotates 719.986031386398° in tropical year (31556925.25 s). Consequently the sun will rise in a new constellation on the day of equinox.

After sidereal year the sun after revolving 360.013969155629° and the celestial sphere after rotating 720.013969155629° will align with the earth. The sun will revolve 0.013969155629° or 50.2889602644 arc-seconds in 1224.51 seconds whereas the reference star will revolve 0.027937769232° in 1224.51 seconds from their respective positions after tropical year to align with the earth in sidereal year. The moon revolves anticlockwise around the earth in the orbit (MO) inclined 5.14° (θ2) to the ecliptic and completes 360° revolution in 2775878.283803747562 seconds or 32.128220877358 days. Celestial sphere rotates 53.858000129778° clockwise whereas the moon will revolve 306.141999870222° anticlockwise in 2360591.47 seconds (length of sidereal

month). Thereby the moon and the reference star will be at the same relative positions after sidereal month. The moon revolves 330.893254995808° in synodic month (2551442.78 seconds) while the sun revolves 29.106745778409°. Thus the moon will be at the same position relative to the sun after synodic month.

Obviously there is no need for any assumption to justify any observed reality or to validate any astronomical phenomenon in this model. The new model has full competency to answer all the questions (see 1.3) for which heliocentric model has no mathematical and logical answers.

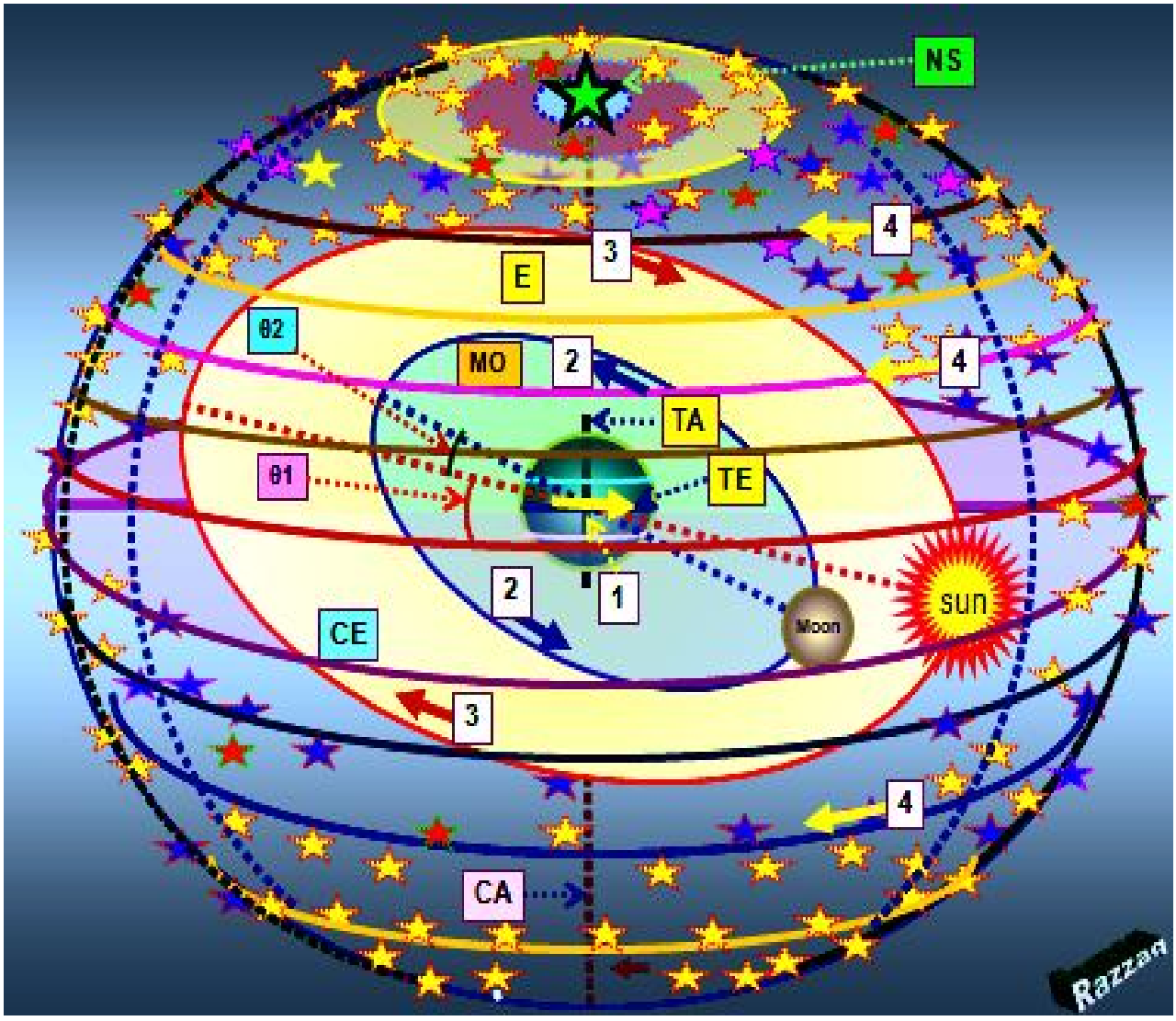

Fig – 7.9: Relative positions and motions of the earth, the moon, the sun and celestial sphere. **CA:** Celestial axis. **CE:** Celestial equator. **E:** The ecliptic. **MO:** Orbit of the moon. **NS:** North Star. **TA:** Terrestrial axis. **TE:** Terrestrial equator. **θ1:** Inclination of the ecliptic relative to the terrestrial equatorial plane. **θ2:** Inclination of moon's orbit to the ecliptic. **Arrows 1, 2, 3 and 4:** Indicate direction of rotation of the earth, revolution of the moon, revolution of the sun and rotation of celestial sphere, respectively.

7.15 Finale

Orbital revolution of the earth around the sun under the influence of gravity as perceived in heliocentric model is an invalid apprehension of solar system. Heliocentric model is based on several mathematically invalid assumptions. Scientific criticism provides sufficient grounds for legitimate refutation of heliocentric model. Therefore, heliocentric model is challenged and denied. A new precise mathematical model of solar system is proposed that has the competency to provide mathematical and logical answers to all the questions which could not be answered with the help of heliocentric model. New model does not need any assumption to justify any observed phenomenon and can be depicted precisely in a single diagram whereas heliocentric model lacks this characteristic. Several separate diagrams have to be made to elucidate different concepts. In new model, all aspects of solar system can be presented with a single physical or electronic model whereas it is impossible with heliocentric model. Further mathematical additions by eminent scientists and learned scholars will make it more precise. Nonetheless, central position of the earth, clockwise revolution of the sun and clockwise rotation of celestial sphere shall never be denied. Mathematical improvements shall be made definitely.

Now no doubt is left that the sun revolves around the earth. Amazingly, orbital speed of 30 km/s could never affect any physical phenomenon on or around the earth. Thank God, the earth has stopped running in the orbit with extremely high speed that could cause alarming situation any time. Now you can feel easy.

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Advancement of science depends on evidences. Scientific theories and models are proposed, modified, improved or denied based on mathematical and logical evidences. Heliocentric model, in this book, is refuted legitimately and new mathematical model of solar system is presented. This book is open for criticism for further improvement. However, criticism should be scientific and logical keeping in view the mathematical evidences presented in this book.

Prof. Dr. Abdul Razzaq
Pir Mehr Ali Shah
Arid Agriculture University
Rawalpindi, Pakistan

This book is an excellent work on solar system. No such book has been published during the last five hundred years. Limitations of heliocentric model are highlighted with the help of mathematical and scientific evidences. It is proved that heliocentric is not a valid scientific model. It cannot answer several relevant questions without assumptions. New model of solar system proposed in this book seems mathematically perfect model and is not based on any assumption.

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